LEVEL II

CROTON RIVER BASIN

AMAWALK DAM

WESTCHESTER COUNTY, NEW YORK
INVENTORY NO. 45

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT CORPS OF ENGINEERS

MAY 24, 1978

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DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, NEW YORK
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10007

2 OCT 1978

NANEN-F

Honorable Hugh L. Carey
Governor of New York
Albany, New York 12224

Dear Governor Carey:

The purpose of this letter is to inform you of a clarification of the guidelines used by this office in assessing dams under the National Program of Inspection of Dams.

Office of the Chief of Engineers has recently provided a clarification that dams with seriously inadequate spillways are to be assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The following dams in your state have previously been assessed as having seriously inadequate spillways, with capability to pass safely only the percentage of the probable maximum flood as noted in each report. They are now to be assessed as unsafe:

I.D. NO.	NAME OF DAM
N.Y. 59	Lower Warwick Reservoir Dam
N.Y. 4	Salisbury Mills Dam
N.Y. 45	Amawalk Dam
N.Y. 418	Jamesville Dam
N.Y. 685	Colliersville Dam
N.Y. 6	Delta Dam
N.Y. 421	Oneida City Dam
N.Y. 39	Croton Falls Dam
N.Y. 509	Chadwick Dam (Plattenkill)
N.Y. 66	Boyds Corner Dam
N.Y. 397	Cranberry Lake Dam
N.Y. 708	Seneca Falls Dam
N.Y. 332	Lake Sebago Dam
N.Y. 338	Indian Brook Dam
N.Y. 33	Lower(S) Wiccopee Dam (Lower Hudson W.S. for Peekskill)

NANEN-F
Honorable Hugh L. Carey

I.D. NO.	NAME OF DAM
N.Y. 49	Pocantico Dam
N.Y. 445	Attica Dam
N.Y. 658	Cork Center Dam
N.Y. 153	Jackson Creek Dam
N.Y. 172	Lake Algonquin Dam
N.Y. 318	Sixth Lake Dam
N.Y. 13	Butlet Storage Dam
N.Y. 90	Putnam Lake (Bog Brook Dam)
N.Y. 166	Pecks Lake Dam
N.Y. 674	Bradford Dam
N.Y. 75	Sturgeon Pool Dam
N.Y. 414	Skaneateles Dam
N.Y. 155	Indian Lake Dam
N.Y. 472	Newton Falls Dam
N.Y. 362	Buckhorn Lake Dam

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

Consequently, it is advisable to implement the recommendations previously furnished in the reports for the above-mentioned dams as soon as practicable.

It is requested that owners of these dams be furnished a copy of this letter and that copies be permanently appended to all reports previously furnished to you.

Sincerely yours,

CLARK H. BENN
Colonel, Corps of Engineers
District Engineer

CROTON RIVER BASIN

AMAWALK DAM

WESTCHESTER COUNTY, NEW YORK
INVENTORY NO. 45

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by: TIPPETTS-ABBETT-McCARTHY-STRATTON

NEW YORK DISTRICT CORPS OF ENGINEERS

MAY 24, 1978

CROTON RIVER BASIN
AMAWALK DAM
INVENTORY NO. 45
PHASE I INSPECTION REPORT

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	AMAWALK (I.D. NO. 45)
State Located:	NEW YORK STATE
County Located:	WESTCHESTER COUNTY
Stream:	MUSCOOT RIVER
Date of Inspection:	27 APRIL 1978

ASSESSMENT

The examination of documents and visual inspection of Amawalk Dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam project, however, has a number of deficiencies which, if not thoroughly monitored, evaluated and remedied, may have the potential for developing into hazardous conditions. Although the dam is not in imminent danger in its present condition, additional investigations should be undertaken to evaluate the need for and type of remedial measures. The investigations should be started immediately and should be performed in accordance with the requirements of the applicable sections of Chapter 4 of the RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS. The immediate investigations should include, but not necessarily be limited to, periodic and systematic observations and measurement of the quantity of seepage, chemical analyses of the seepage discharge, piezometric observations, seepage and stability analyses. Other investigations, including sampling and testing may be found necessary to evaluate the condition of the structures and their foundation.

The total discharge capacity of the spillway and regulatory outlets at maximum pool is about 6,470 cfs. This is less than the estimated probable maximum flood (PMF) of 35,000 cfs and also less than the standard project flood of 13,370 cfs, both as determined by the Corps of Engineers screening criteria. The project discharge capacity is, therefore, seriously inadequate according to the Corps of Engineers adopted general principle that structures be designed for the maximum flood reasonably characteristic of the region, which is, in practice, the Standard Project Flood. Additional hydrologic investigations to more reliably estimate the PMF are recommended; site-specific characteristics of the watershed, such as surcharge storage at the dam and upstream lake control should be considered.

In addition to the investigations recommended above, the following improvements are suggested:

- Correct deficiencies related to surface drainage.
- Remove vegetation growing on embankments and treat animal burrows.
- Repair spillway walls.
- Develop programs for operation, maintenance and inspection.

Eugene O'Brien

Eugene O'Brien, P.E.
New York No. 29823

Approved By:

Col. Clark H. Benn
New York District Engineer

Date: 30 June 78

OVERVIEW OF EMBANKMENT, SPILLWAY OUTLET FOUNTAIN AND PUMPHOUSE

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
AMAWALK DAM, INVENTORY NO. 45
CROTON RIVER BASIN
WESTCHESTER COUNTY, NEW YORK

SECTION I PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I Inspection reported herein was authorized by the DEPARTMENT OF THE ARMY, NEW YORK DISTRICT, CORPS OF ENGINEERS by letter dated 31 March 1978, in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367, 8 August 1972.

b. Purpose of Inspection

The purpose of this inspection and report is to investigate and evaluate the existing conditions of the subject dam in order to: identify deficiencies and hazardous conditions; determine if they constitute hazards to human life or property; and notify the State of New York of these results along with recommendations for remedial measures where necessary.

1.2 DESCRIPTION OF THE PROJECT

a. Description of the Dam and Appurtenant Structures

The Amawalk Dam is composed of a 1,270 foot long earth embankment and a 50 foot wide ogee type masonry spillway. Two 30-inch diameter pipes serve as low level outlets; the flow through these pipes is regulated by gate valves.

The crest of the embankment is 55 feet wide, the upstream slope is 1 on 5 and the downstream slope is 1 on 3. Near the two sidewalls of the spillway, which is located slightly left (looking downstream) of the center of the embankment, the downstream slope of the embankment is locally steepened. The maximum height of the embankment above the old stream bed, which is located right of the center of the embankment, is 82 feet. The downstream slope, the crest and about 20 feet wide top section of the upstream slope are covered with grass. The remainder of the upstream slope is protected by riprap. There are two vertical masonry rubble walls inside of the embankment; one of these, the center core wall, runs below the center of the crest. The second wall, called the guard wall, is parallel with the first and located about 290 feet upstream of the center wall. The dimensions of the center wall are: width at the base 15 feet, width at the top 8 feet, maximum height: 85 feet. It appears that in line with this wall the crest is raised approximately 2 feet over a width of 12 feet. The guard wall is 8 feet wide at the base, 4 feet wide at the top and its maximum height is 28 feet.

There is a small auxiliary earthfill embankment constructed west of the main embankment, near the intersection of Routes 35 and 202. The auxiliary embankment is about 300 feet long and 25 feet high. Its upstream slope is protected by heavy riprap; the crest and the downstream slopes are grass covered.

The ungated spillway is constructed of masonry rubble; the surface of its 50 foot wide ogee section is faced with stone blocks. The ogee is flanked by two side walls also built of stone blocks. The elevation of the spillway crest is 400 feet (above M.S.L.-Croton Datum), which is 10 feet below the crest of the embankment.

The intake structure of the low level outlet is a masonry intake tower located near the upstream toe of the embankment. From this tower a 9.5 foot inside diameter conduit leads to the center wall. The center wall provides a seal around the outlet conduit which bifurcates into two 30-inch diameter pipes at the wall. These two pipes continue downstream, inside of a 12 foot diameter brick conduit, from the center wall to the gate house located at toe of the dam. A gate vault, which is near and downstream of the center wall, houses two 30-inch diameter gate valves and their controls. In the gate house the two 30-inch diameter pipes further branch into four 20-inch diameter pipes. The flow is controlled by two 30-inch diameter gate valves located upstream of the branching and four 20-inch diameter valves, one on each pipe, downstream of the branching. Downstream of the gate house, the four 20-inch diameter pipes continue underground and terminate in a circular discharge fountain from which the water cascades to the tailrace channel of the spillway. There is a drainage vault just upstream of the discharge fountain for draining the gate house and also for draining the water out of the outlet pipes and fountain when required. The spillway tailrace channel is 50 feet wide; it is stone paved and bordered by two vertical stone walls. The water released into the tailrace channel contributes to the water supply of the City of New York.

A 20-inch diameter pipe leads from the discharge fountain to a pump house downstream of the fountain. The other user of the water from the Amawalk reservoir, the Westchester County Water District, pumps water from this pump house to its facilities located south of Route 35.

b. Location

Amawalk Dam is located on the Muscoot River, a tributary of the Croton River, near Route 35 and about 0.6 miles east of the intersection

of this highway with Route 202. The nearest village is Amawalk located just north of the intersection. The closest sizable settlements are: Yorktown Heights, about 2 miles to the southwest and Katonah, about 4 miles to the southeast.

c. Size Classification

The dam is 82 feet high and therefore it is classified as an "intermediate" dam (between 40 and 100 feet high).

d. Hazard Classification

The dam is in the "high" hazard potential category.

e. Ownership

Amawalk Dam is owned and operated by the New York City Bureau of Water Supply (BOWS); the operation and maintenance of the dam and related structures are carried out by the Katonah Section of the East-of-Hudson Division of BOWS.

f. Purpose of Dam

The dam impounds water for the use of the City of New York and the County of Westchester.

g. Design and Construction History

The dam and its appurtenant structures were designed by the Department of Public Works of New York in the early 1890's. The construction contract was awarded to John McQuade; the works were completed in 1897.

h. Normal Operating Procedures

Water is released from the Amawalk reservoir either by the low level outlets or over the spillway. Approximately 5 mgd is released into the Muscoot River for the use of New York City. The other user of the water, Westchester County Water District, pumps water from the discharge fountain at a rate ranging from 2.5 to 4.5 mgd.

1.3 PERTINENT DATA

a.	Drainage Area (sq. mi.)	19.5
b.	Discharge at Dam Site (cfs)	
	Maximum known flood (October 16, 1955)	1,677
	Ungated Spillway at Design Pool (El 405)	2,180
	Ungated Spillway at maximum pool (El 410)	6,170
	Maximum capacity of low level outlets (Estimated)	300
	Total Discharge, Max. pool (El 410)	6,470
	Average daily discharge	12.4
c.	Elevation (ft above MSL-Croton Datum)	
	Top of dam	410.0
	Maximum design pool (top of riprap)	405.0
	Spillway crest	400.0
	Tailrace channel	324.0
	Invert low level outlet	330.5
	Discharge level at fountain	331.0
d.	Reservoir	
	Length of maximum pool, miles	2.4
	Length of shoreline (spillway crest), miles	8.5
	Surface area (spillway crest), acres	606.1
e.	Storage, (acre-feet)	
	Spillway crest	20,500
	Maximum design pool	23,170
	Top of dam	24,975
f.	Dam	
	Embankment	
	Type:	Earthfill with rubble masonry central core wall and upstream guard wall
	Length, ft.	1,220
	Upstream slope:	1 on 5
	Downstream slope:	1 on 3
	Impervious core:	rubble masonry central core wall 15 feet wide at the base, and 8 feet wide at the top
	Crest elevation, ft.	410
	Crest width, ft.	55
	Grout curtain:	none

g. Spillway

Type:	Ungated - ogee; masonry rubble with stone facing	
Length, ft.		50
Crest elevation MSL -	Croton Datum	400.00
Crest elevation MSL -	Sandy Hook Datum	399.55
Upstream channel:	none	
Downstream channel:	50 ft. wide Stone side walls, stone pavement discharges into Muscoot River	

h. Regulating Outlets

Upstream of central core wall:

Intake channel and tower near upstream toe; 9.5 ft. inside diameter masonry conduit between intake tower and central wall.
No regulatory gates.

Downstream of central wall:

Two 30-inch diameter pipes regulated by 30-inch gate valves at gate vault (valves are not functioning) and two additional 30-inch diameter gate valves in gate house. Both 30-inch diameter pipes bifurcate in gate house into 20-inch diameter pipes. These are controlled by 20-inch diameter gate valves in the gate house.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Geology and Foundation

The Bureau of Water Supply files contain no data on site geology and foundation conditions. The search in connection with this inspection did not reveal any information on exploratory borings or foundation investigations made prior to or during construction. However, there is data available in the literature on the general geology of the area (References 6, 7 and 8 in Appendix F.)

The bedrock in the area of the Amawalk dam and reservoir is composed of Precambrian formations: granitic and schistose gneisses and paragneisses. There are also some local interlayers of amphibolite and marble. The rock is exposed at several places around the reservoir, one exposure is near the left abutment of the main embankment. The rock appears to be competent although some members are fractured and others contain wide open joints. These observations, however, may reflect only surface conditions. As indicated in Reference 8, a minor fault cuts through the lower portion of the reservoir; it strikes in NW-SW direction and passes near the auxiliary embankment.

b. Embankments and Appurtenant Structures

The dam was engineered by the Department of Public Works of New York. BOWS' files contain some project drawings; drawings obtained from the BOWS Appendix A. One of the Aqueduct Commission's Reports, Reference 10, also shows a cross-section of the dam. The ASCE and USBR publications, given as References 3 and 4, contain some data on the seepage profile through the embankment; these references describe the findings of a seepage study of several dams made by the U.S. Bureau of Reclamation in the early 1920's. No data has been found for the auxiliary dam.

2.2 CONSTRUCTION RECORDS

No information has been located in relation with the construction of the project except the year of completion, 1897, and the name of the contractor, John McQuade.

2.3 OPERATION RECORD

The pool level and rainfall are recorded on a daily basis. Except for a record of water released to Westchester County Water District, the secondary user, there are no records of gate operation or discharges. There is no

operation or maintenance manual. Work orders in connection with repairs and maintenance are in the files of BOWS' District Office. Although the BOWS District and Section forces visually inspect the dam from time to time, no systematic monitoring of the performance of the dam is in effect.

2.4 EVALUATION OF DATA

The existing data have been made readily available by the New York and Katonah Section Offices. In addition, the District and Section Engineers contributed valuable observations concerning the behavior of the structure in the past years. The drawings provide no information on the embankment material and the nature of the foundation; also, they do not represent the as-built conditions in all respects. The drawings of the spillway and low level outlets are more detailed and contain adequate data for the Phase I inspection and evaluation of these structures.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection of Amawalk Dam and its auxiliary embankment was made on April 27, 1978. The weather was cloudy and windy; temperature in the 40-45F° range. The inspection was made 8 days after the last rainfall. The reservoir level at the time of the inspection was 2 inches above spillway crest level: at 400.17 feet.

b. Embankment and Abutments

The earth embankment, which was completed in 1897, shows no signs of major distress. The vertical and horizontal alignment of the crest appears to be unchanged; there are no cracks visible on the crest, downstream slope or portion of upstream slope exposed above reservoir level. There are no depressions, indications of sliding, sloughing, except as noted below. The grass covering the downstream slope, crest and portion of upstream slope above riprap is generally well maintained. However, the following adverse conditions were noted:

*(A) Seepage appears along the right abutment contact and on the lower portion of the downstream slope on the right side of the embankment. A reddish-brown deposit is evident where the water emerges from the ground or embankment slope and along the toe ditch. The Section Engineer thought that seepage has recently increased somewhat in this area. The water is clear, it does not seem to carry eroded particles; the reddish-brown material appears to be either bacterial growth or deposition of dissolved minerals. The toe portion of the slope surface in this area is saturated, soft and covered with bushes and also shows minor surface irregularities - possibly tractor track marks.

(B) The toe ditch on the right side of embankment contains debris, loose deposits and vegetation growth.

(C) The ground downstream of the embankment seepage described in (A) is soaked, wet and covered with marsh vegetation.

(D) Surface erosion was noted on the crest on both sides of the spillway wall.

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*The location of these observations are marked on the enclosed sketch by the corresponding capital letters in parenthesis.

(E) The maximum size of the riprap is 10 inches and many of the stones are weathered and unsound. There is some vegetation growth; bushes and saplings, in the riprap area.

(F) There is some damage to the riprap near the left spillway wall.

(G) Some animal burrows - 8 inch diameter, several feet deep, were noted on the upper portion of the downstream slope.

(H) The two surface drain ditches (one along the wall of the spillway and another along the toe of the embankment) which collect all surface water from the downstream slope of the left side of the embankment have no outlet on the surface. Water from these ditches enters the ground behind the gate chamber wall and exits through the wall. The embankment slope in this area shows several depressions indicating a loss of fines.

(I) Seepage emerges from the wall left of the gate chamber and also from between the stones serving as slope protection for the slope left and downstream of the gate chamber. The reddish-brown deposit mentioned in (A) is also apparent here.

(J) The ground downstream of the gate chamber is wet, the water is near or at the surface. The ground is soft; a walkway made of boards has been constructed here to facilitate the approach to the gate house.

(K) There is a brick-enclosed spring on the natural slope downstream on the left side of the dam.

c. Spillway and Tailrace Channel

The masonry spillway structure appears to be in good condition. The stones facing the spillway ogee section are sound and show no sign of movement or deterioration; the spillway walls show only minor cracks and some water seepage from the joints. During the inspection, water was flowing over the spillway. For this reason, possible leaks in the ogee section could not be observed. The Section Engineer did not notice such leaks during previous visits. On the negative side:

(L) Both spillway inlet walls at reservoir level are in damaged condition; large stones comprising the masonry wall are loose and/or dislocated.

(M) The walls of the tailrace moved inward both on the left and right side. Some of the stones in the wall are loose. There are several cracks in the wall and some of the stones have fallen into the tailrace channel.

(N) The tailrace channel has some debris accumulation.

d. Regulating Outlets

Most of the intake tower and the portion of the intake conduit upstream of the center core wall are submerged, and were therefore, not inspected. The gate house and the brick walled lower pipe conduit are in good condition; no cracks are evident. The pipes and valve-housings show no signs of significant corrosion.

The following observations of adverse nature were made:

(O) Seepage is evident on the ceiling and walls of the gate chamber and pipe conduit. Water is flowing on the floor of the conduit and 2-3 inches of water and semi-solid deposits cover the floor of the lower level of the gate chamber. In the conduit the seepage is more intense near the gate chamber and decreases toward the center core wall. Seepage is greater on the left side of both gate house and conduit. The reddish-brown deposit mentioned in (A) is noticeable on the left side of these structures. The right side of the conduit shows white mineral deposits - these are thought to be dissolved from the mortar. At the time of the inspection, the Section Engineer pointed out a seepage spot on the right wall of the gate house that he had not noticed before.

(P) The components of the gate operating structures (stands, stems, gears, etc.) are corroded and rusted at most places and some of the parts (stands) are broken. The 30-inch diameter gate valves in the gate vault, located downstream of the center wall, have not been operated for many years and it is presumed that they are not operational. These valves are in the fully open position. There were no major deficiencies noted in connection with the valves located in the gate house. Some of these gates, however, cannot be closed completely. The valves are not periodically inspected and, except for some greasing of the gears, no inspection or maintenance is performed.

(Q) The stone wall left of the gate chamber has moved about 3-inches downstream and 2-inches vertically downward along a construction joint. This movement appears to be the result of inadequate surface drainage mentioned in (H).

e. Reservoir Area

There were neither slides, rockfalls, sloughing or other signs of instability noted in the vicinity of the dam nor were objectionable amounts of floating debris observed in the reservoir.

3.2 EVALUATION OF OBSERVATIONS

Although deficiencies were observed there is no indication that the dams are in imminent danger. A number of the deficiencies listed in the previous paragraph are minor and may be either tolerated or corrected by the maintenance forces. Other deficiencies described above, however, represent conditions which may have potential for further deterioration; for this reason, these conditions need to be further investigated.

The most significant of the observations in this later category are the persistent foundation seepage on the right side of the embankment and the seepage in the area of the gate chamber and pipe conduit. (Items(A) (C) (I) (J) (O). Since the pattern of seepage and possible changes in this pattern are not known and little is known about the condition of the embankment and foundation, additional investigations and a program of systematic observations are warranted.

It is necessary to improve surface drainage on the left side of the embankment (Items (H) (J) (O)). The inadequate drainage noted in (H) may contribute to or possibly cause most of the seepage observed in the gate chamber and pipe conduit. The surface water can be diverted from behind the gate chamber and adjacent walls by surface drainage improvements requiring only minor effort. The correction of the condition described in Items (H) (J) (M) and (O) may require more extensive construction.

Most of the conditions covered by Items (B) (D) (E) (F) (G) (L) and (N) can be handled as part of the maintenance work.

The gate operating structures - Item (D) - need to be inspected periodically and repaired if necessary. The improper functioning or failure, of these components may not, for all practical purposes, reduce the maximum discharge capacity of the project but could hinder the water supply releases and may not allow rapid emptying of the reservoir.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

Amawalk Reservoir discharges approximately 5 mgd into the water supply system of New York City. In addition, an average 3 mgd is released to the Westchester County Water District. During the summer months, in July and August, this quantity is increased to 4.5 mgd. The release to Westchester and the flow over the spillway varies but the release to New York is kept nearly constant. In order to provide New York with 5 mgd, the total outflow is regulated by the gate valves located in the gate house. The release facilities are not calibrated, the quantities released are only estimated.

4.2 MAINTENANCE OF DAM

The reservoir is frequently visited by the watershed inspector and gate operators who do not necessarily examine the dam or other project features. Although the Section Engineer inspects the dam and other structures periodically, there is no formally established program of inspections and there are no operation and maintenance manuals for the project.

The grass slope protection on the main embankment and auxiliary embankment is mowed every few months. Maintenance of the grass surfaces on the main dam appears to be adequate except for the growth of brush at the toe of the right abutment. Maintenance of the surface of the small auxiliary embankment, which is not as easily accessible, is less than adequate. No regular maintenance procedures are established for the masonry structure and spillway, although some minor repair of stone work is done occasionally. The toe collector ditch at the left embankment is not cleaned and the amount of seepage is not monitored.

4.3 MAINTENANCE OF OPERATING FACILITIES

The 30 and 20-inch diameter gate valves in the gate house used for regulating the water releases appear to be in acceptable operating condition, although some of these gates cannot be closed fully. The 30-inch diameter valves in the upstream valve vault have not been operated for many years and it is presumed that they are not in working condition. There is no periodic inspection of the operating facilities and there is no regular program of repairs.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Amawalk Reservoir is located on the Muscoot River, a small tributary of the Croton River, located on the west-central boundary of the latter's basin. The total drainage area at Amawalk Dam is 19.1 sq. mi. The area is in a region of rapidly growing suburban development, with considerable density in limited village areas and shopping centers. The topography is characterized by steep hills and ridges running in a general north-south direction, interspersed with flat valleys containing lakes and swamps. The total area of lakes and swamps is 3.85 sq. mi., or 20 percent of the drainage area. The largest lakes, Lake Mohopac and Kirk Lake at the northern limits of the basin, appear to modify the runoff from 5.56 sq. mi. or 29 percent of the drainage area. The basin has an unusual length to width ratio of four, which in addition to the natural storage, can be expected to modify flood runoff.

5.2 SPILLWAY CAPACITY

The spillway design is unusual for a structure built in 1897 in that it is shaped to conform to the overfall jet. The length is 50 feet which is small compared with other spillways for dams in the Croton Basin, having similar drainage areas. The maximum head possible between the crest of the spillway and the top of the dam is 10 feet. No data are available on the discharge-rating of the spillway, so that weir coefficient was assumed to vary from 3.0 at one foot head to 3.9 at five feet of head and above. The computed capacity at maximum head is 6,170 cfs. The spillway rating curve is shown on Figure 1 of the Appendix.

5.3 RESERVOIR CAPACITY

The total reservoir capacity at the spillway crest is 6,692 million gals. (20,500 acre-feet). The storage capacity curve, based on a table furnished by the Department of Water Supply, is shown on Figure 2. The capacity curve has been extrapolated to an elevation corresponding to the top of the dam and indicates a surcharge storage above the spillway crest of 4,475 acre-feet, which is equivalent to a runoff depth of 4.4 inches over the drainage area. This is an important factor in considering the adequacy of the spillway to pass design floods.

5.4 FLOODS OF RECORD

The greatest floods in the Croton River Basin since completion of

the New Croton Dam in 1905 and probably since the completion of Amawalk Dam in 1897 were in August and October, 1955. The record of these floods at the dam is as follows:

Date	Elev. (feet)	Head (feet)	Discharge (cfs)	(cfs/sq. mi.)
August 20-21, 1955	403.33	3.33	1,050	55.0
October 16, 1955	404.33	4.33	1,667	87.3

The record of precipitation at the dam indicates that 6.96 inches occurred in three days from August 12-14, inclusive, followed by 6.66 inches on August 17 and 18, for a total of 13.62 inches in eight days. The October storm was more concentrated with a total of 9.06 inches in three days from October 14-16, inclusive, of which 5.95 inches fell October 15.

Although the precipitation in the 1955 storms appears to have been as severe in the Amawalk Basin as the other parts of the Croton River Basin, the peak runoffs per square mile were considerably less, indicating a lowe flood potential for the Amawalk.

5.5 OVERTOPPING POTENTIAL

The maximum spillway discharge capacity of 6,170 cfs given in Paragraph 5.2 above has been compared with generalized flood criteria as explained below. The Probable Maximum Flood for the 19.1 sq. mi. drainage area has been extrapolated from maps of Probable Maximum Flood Potential for selected sizes of drainage (Ref. 11). The smallest drainage area for which floods have been plotted was 100 sq. mi. The extrapolation to 19.1 sq. mi. must be considered approximate but indicates a Probable Maximum Flood peak inflow of about 35,000 cfs. or about 5.67 times the spillway discharge capacity.

A second criteria for evaluating a design flood is the Standard Project Flood which is usually about one half of the Probable Maximum Flood. Derivations of Standard Project Floods in the Lower Hudson Basin are available in a report made for the Corps of Engineers (Ref. 12). Data in this report permitted interpolation of the Standard Project Flood for an area of 19.1 sq. mi. and indicated a flood potential of 700 cfs per sq. mi. or a total discharge of 13,370 cfs on 2.17 times the spillway capacity.

5.6 EVALUATION

The estimated Probable Maximum Flood inflow of 35,000 cfs and the Standard Project Flood inflow of 13,370 cfs must be considered as representing potential inflow to a reservoir from a drainage area that has little

natural or artificial storage. To properly evaluate the relation between Amawalk Dam spillway capacity and the probable outflow from these design floods it would first be necessary to develop complete hydrographs and route them through the available storage. If such hydrographs were based on average drainage area conditions in the general region, they still would not reflect the affect of upstream surface storage in the basin. To evaluate time conditions it would be necessary to develop hydrographs for sub-areas and route them through related storage areas. Without this latter detailed analysis, it is not possible to say whether or not the spillway capacity is inadequate relative to either of the design floods.

Because of the relatively small spillway capacity relative to potential design flood inflows, it is advisable that further hydrologic analyses be made for the Amawalk Dam.

5.7 POTENTIAL FOR LOSS OF LIFE DOWNSTREAM

The Muscoot River between Amawalk Reservoir and its outlet in New Croton Reservoir flows in a steep valley about 3 miles long with an average slope of approximately 60 feet per mile. In the event of a failure of Amawalk Dam a flood wave in the form of a hydraulic bore with high velocity and destruction forces could be expected.

The hills adjacent to the valley are rapidly developing with suburban homes, most of which appear to be on high ground. However, some homes, particularly those adjacent to Highway 35 which crosses the valley immmediately below the dam, are low enough to be destroyed by a flood wave from a dam break.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations did not indicate any serious structural problems with the masonry spillway section or sign of major distress in connection with the earth embankment.

The spillway walls show only minor cracks and some water seepage from the joints. It was not possible to ascertain the existence of additional leaks on the face of the chute, if any, because of the water flowing over the spillway.

b. Design and Construction Data

No design computations or other data regarding the structural stability of the spillway or earth embankments are available. Data or information regarding the construction of these structures has not been located.

Although there are no design computations available, it is likely that the spillway had been designed in accordance with Chapter VI, Overflow Weirs of E. Wegmann's book "Design and Construction of Dams" (Reference I) and therefore it may be considered stable. Mr. Wegmann, at the time when the dam was put in service, was an engineer of the Aqueduct Commission. His theoretical studies and calculations explained in his book, were generally followed by the designers of dam projects in the area. It should be noted that flashboards had been previously installed on top of the spillway without adverse effects.

c. Operating Records

Records of operation and repairs are available at the Katonah Section of the BOWS. No major operational problems which would affect the stability of the spillway or earth embankment were reported.

d. Post-Construction Changes

There are no post-construction changes recorded.

e. Seismic Stability

The dam is located in Seismic Zone No. 1,(Reference 13) therefore, no seismic analyses are warranted.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

Phase I investigation of Amawalk Dam did not indicate conditions which would constitute an immediate hazard to human life or property. On the basis of the performance of the spillway and the earth embankment as well as engineering judgement, both the spillway and the earth embankment are considered not to be unstable in their present condition. The dam project, however, has a number of deficiencies, the causes of and circumstances related to some of which are not sufficiently defined. These deficiencies if not thoroughly monitored, evaluated and remedied, as required, may have the potential of developing into hazardous conditions.

It should be noted that the design of the embankment dam does not follow the usual geometric design generally in use in the area at the time of the construction indicating that adverse foundation conditions and/or poor quality construction materials had been encountered by the designers. Amawalk Dam has a wider crest, flatter slopes - particularly flatter upstream slope - than other dams in the area and it also has double masonry protection wall.

The total discharge capacity of the spillway and regulating gates without overtopping of the dam is approximately 6,170 cfs. This is less than the estimated probable maximum flood (PMF) of 35,000 cfs and also less than the standard project flood of 13,370 cfs, both as determined using the Corps of Engineer's screening criteria. The project discharge capacity is therefore inadequate relative to either of the design floods.

For the reasons described above and also because of the inadequate spillway capacity, Amawalk Dam requires special attention. Measures and improvements are required in connection with the most serious deficiencies. Some of these measures need to be carried out immediately.

b. Adequacy of Information

The information related to the spillway and low level structures has been found adequate for the Phase I investigation. Design and performance data related to the embankment, however, were not sufficient to judge the effects of deficiencies noted in Paragraph 3.1 on the future performance of the dam. In addition to the dams unusual design there is a long history of seepage problems in connection with Amawalk Dam. Under these circumstances further evaluation of the conditions is essential.

For the proper operation and maintenance of the project, the following items would be required:

a. Up-to-date project drawings.
b. Operation and maintenance manuals.
c. Ratings for the release facilities.
d. Inspection schedule and record of inspections.
e. Monitoring schedule and record of data obtained by monitoring.
f. Schedule and record of maintenance.
g. Periodic inspection of the spillway for leaks at the time when the reservoir level is below spillway crest.

c. Urgency

Some of the recommended observations and corrective measures need to be carried out on a priority basis - otherwise damage may occur at some of the project features.

d. Need for Additional Investigations

Although the dam is not in imminent danger in its present condition, additional investigations should be undertaken to determine the exact nature and cause of the seepage conditions and to evaluate the need for and type of remedial measures. The investigations should be initiated immediately.

The additional investigations should be performed in accordance with the requirements of the appropriate sections of Chapter 4 of the RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS. The immediate investigations should include, but not necessarily be limited to, periodic and systematic observations and measurement of the quantity of seepage, chemical analyses of the seepage effluent, piezometric observations as required, as well as seepage and stability analyses of the affected areas. Other investigations, including sampling and testing, may be subsequently found necessary to evaluate the condition of the embankment and the foundation.

It is recommended that the changes in the quantity of seepage, chemical composition of the seep water and of the solids carried by the seepage discharge and also the movement of some of the structures be monitored periodically and systematically. This monitoring - deemed to be the first priority item - can be accomplished by cleaning the drainage facilities and installing seepage measuring devices such as weirs, flowmeters, etc. and also by installing simple movement measuring gauges and surface reference points.

As second priority item, the seepage pattern through the embankment and the foundation needs to be defined and the condition of the embankment and its foundation needs to be determined. This part of the

investigation may require the installation of piezometers, movement devices and also obtaining and testing samples from the embankment and foundation as well as seepage and stability analyses.

It is further recommended that additional hydrologic studies be made to more reliably estimate the PMF for this reservoir; the studies should consider site-specific characteristics of the Amawalk watershed such as surcharge storage at the dam and upstream lake control.

To evaluate the potential for loss of life in case of failure of the dam, it is recommended that a survey be made of the development in the Muscoot River valley between Amawalk Dam and New Croton Reservoir, including a census of all homes, school, churches or recreation facilities located within a height of 100 feet above the river channel.

7.2 RECOMMENDED MEASURES

a. The results of the additional investigations recommended in Paragraph 7.1d may indicate a need for corrective measures in connection with the seepage conditions which were observed at locations (A), (C), (I), (J), (O) and are described in Paragraph 3.1. Recommendations concerning possible corrective measures can only be made after the completion of the additional investigations.

b. The surface drainage, particularly in areas described at locations (D) (H) and (J) of Chapter 3.1 needs to be improved immediately in order to prevent further movements of the wall left of the gate chamber (described at location (Q)).

Additional improvements listed below can be handled as part of the maintenance work:

c. The gate operating structures need to be inspected periodically and repaired when the inspection reveals the need.

d. The minor vegetation growth noted on both upstream and downstream slopes of the main embankment should be removed. There is much denser and heavier growth, however, on the auxiliary dam which should also be removed.

e. After the evacuation of the occupants, the animal burrows should be backfilled.

f. The damage to the spillway walls should be repaired. The movements of the spillway chute walls will probably stop after the downstream drainage improvements have been carried out.

g. Minor riprap damage should be corrected. The small size riprap on the main embankment is subject to damage by major storms. An inspection, and, if needed, corrective work should be carried out after such storms. The riprap on the auxiliary dam is considerably heavier than that on the main dam; there are some depressions, however, in this riprap which require some maintenance work.

DRAWINGS

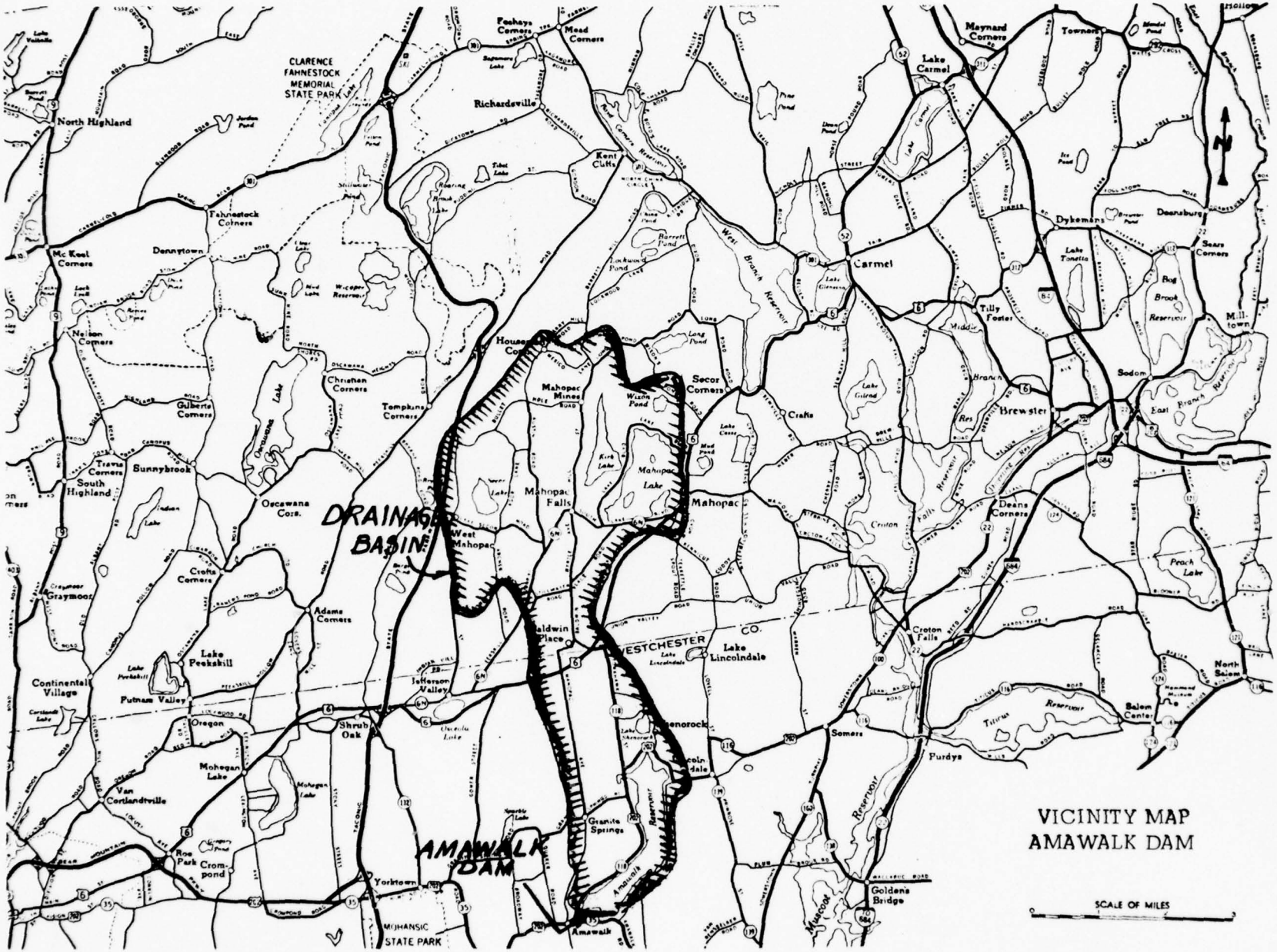
APPENDIX A

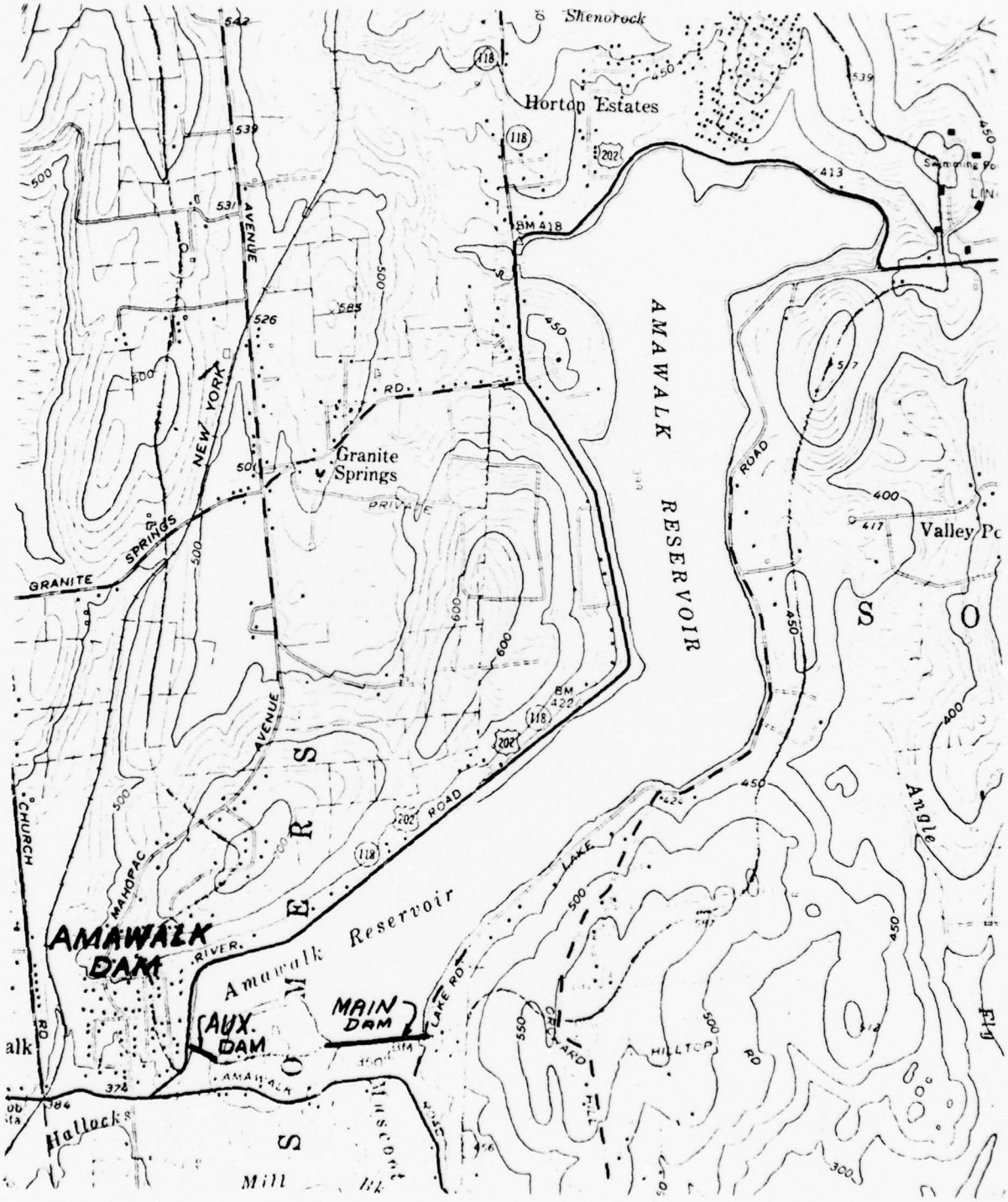
APPENDIX A

a. List of Drawings Reviewed in Connection with Phase I Investigation of Amawalk Dam

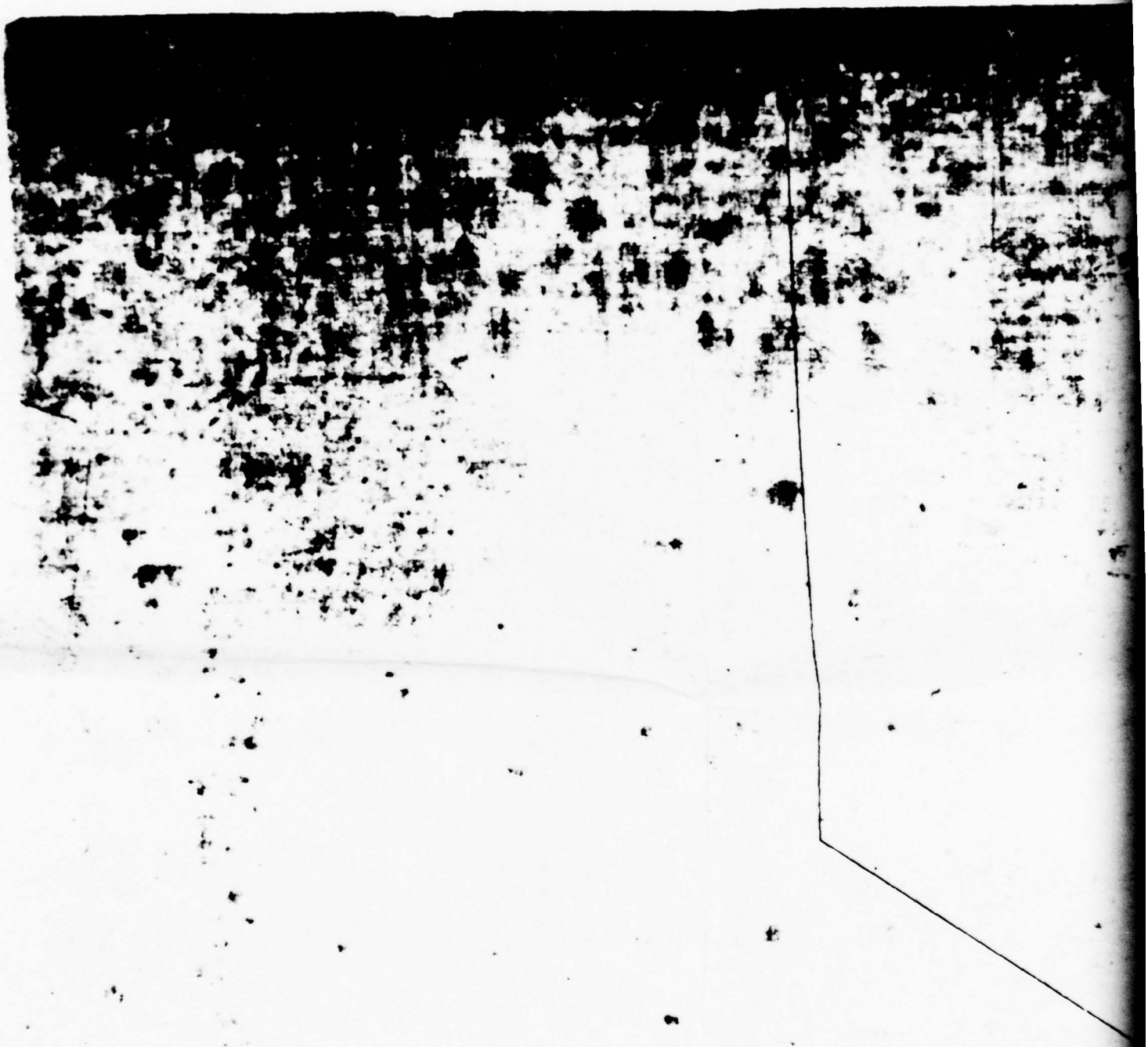
DRAWINGS	BOWS REFERENCE NO.
General Plan of the Embankment	No. 9985*
Section through Center of Core Wall and Embankment - Elevation of Main Dam - Elevation of Guard Dam	No. 9983*
Elevation and Section through Spillway	No. 9979*
Sections of Intake Tower, Upstream Conduit and Spillway	No. 9980*
Section of Masonry Center Core Wall	No. 9976*
Profile Showing Grades of Pipe Conduits, Spillway and Outlet Pipes	No. 9978*
Plan of Gate House and Vault - Gates in Gate House - Gates in Vault	No. 10044
Plan of Outlet Pipes - Elevation and Section of Gate House	No. 9981
Plan, Section and Details of Outlet Pipes and Gates	No. 3613
Section of the Embankment	From Reference 9

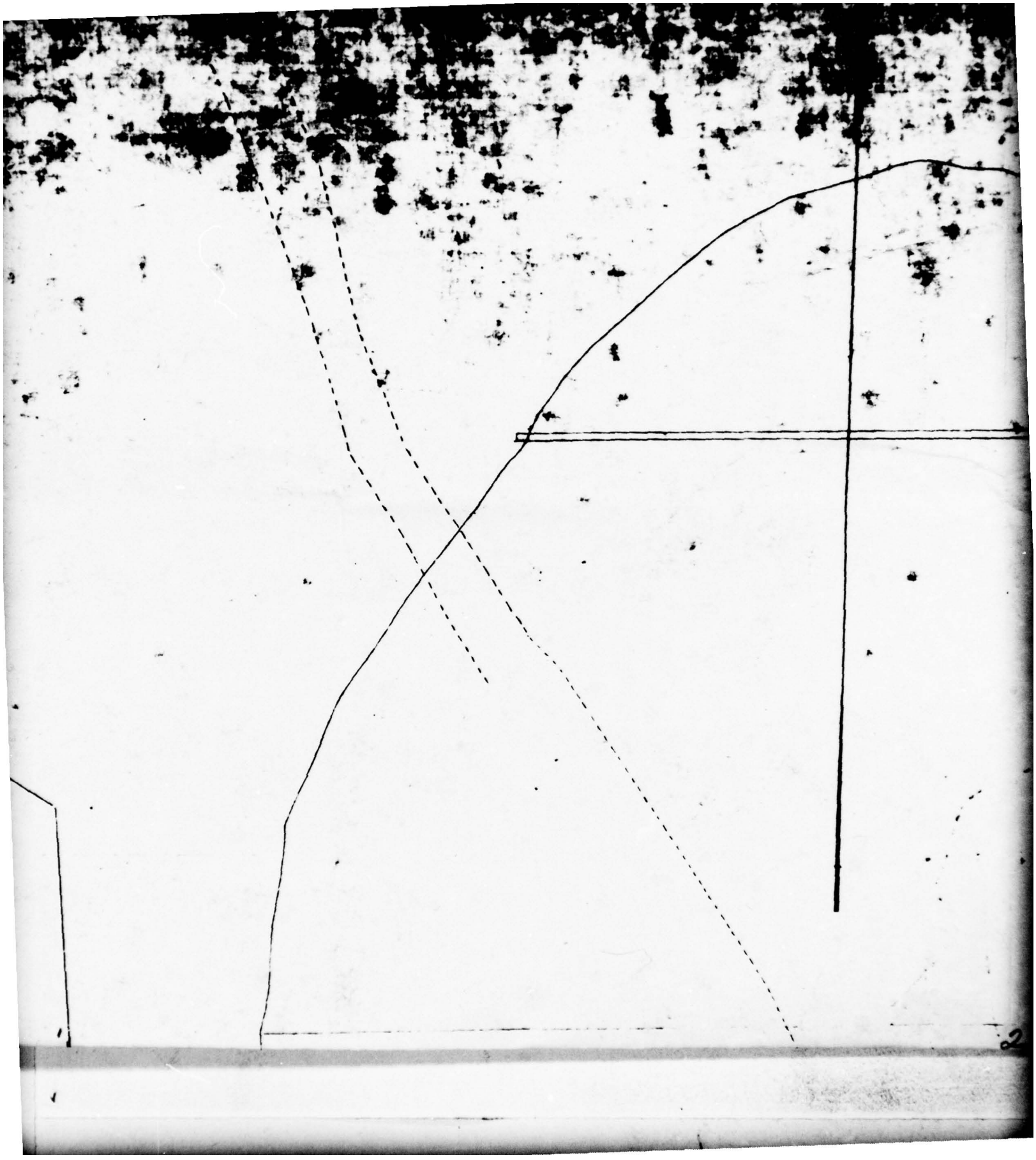
*Drawings reproduced in this report - see Item b in this Appendix

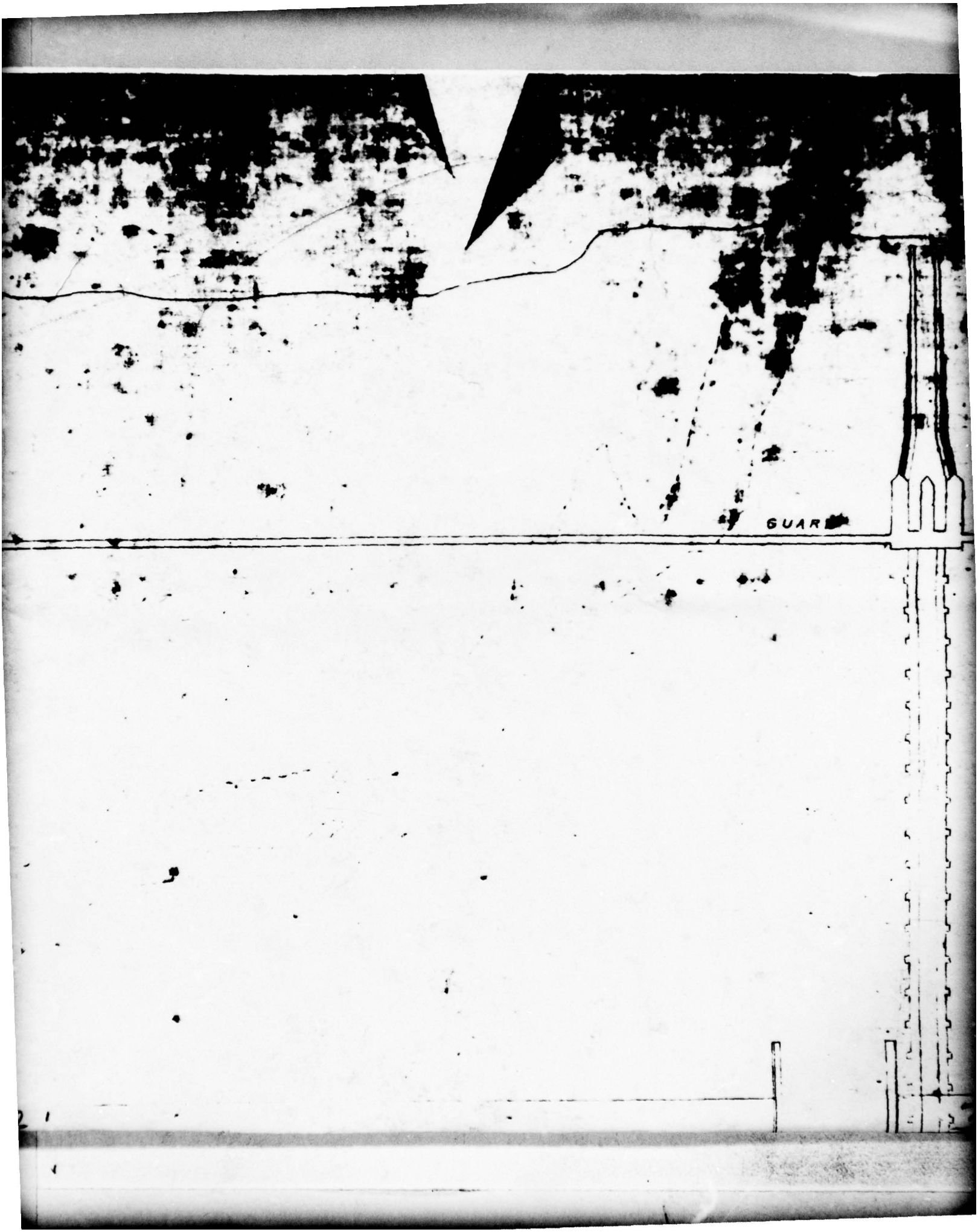

CLARENCE FAHNESTOCK MEMORIAL STATE PARK
North Highland
Fahnestock Corners
Mc Kool Corners
Dennytown
Nelson Corners
Gilberts Corners
Travis Corners
South Highland
Sunnybrook
Oscawana Corners
Croft Corners
Graymoor
Adams Corners
Lake Peekskill
Continental Village
Putnam Valley
Oregon
Shrub Oak
Mohegan Lake
Van Cortlandtville
Roe Park
Crompond
Yorktown
MOHANSIC STATE PARK
Peekskill Corners
Mead Corners
Richardsville
Kent Cliffs
Christian Corners
Tompkins Corners
Mahopac Mines
Wiccopee Pond
Secor Corners
Crafts
Mahopac Falls
Mahopac
West Mahopac
Baldwin Place
Granite Springs
Amawalk
Yorktown
Lake Carmel
Maynard Corners
Townsend
Dykemans
Deansburg
Carmel
Sears Corners
Tilly Foster
Millerton
Sodom
Brewster
East Branch Reservoir
Deans Corners
Croton
Croton Falls
Lake Lincolndale
Somers
Purdys
North Salem
Salem Center
Reservoir
Golden's Bridge
Muscoot
DRAINAGE BASIN
AMAWALK DAM
WESTCHESTER CO.
VICINITY MAP
AMAWALK DAM
SCALE OF MILES

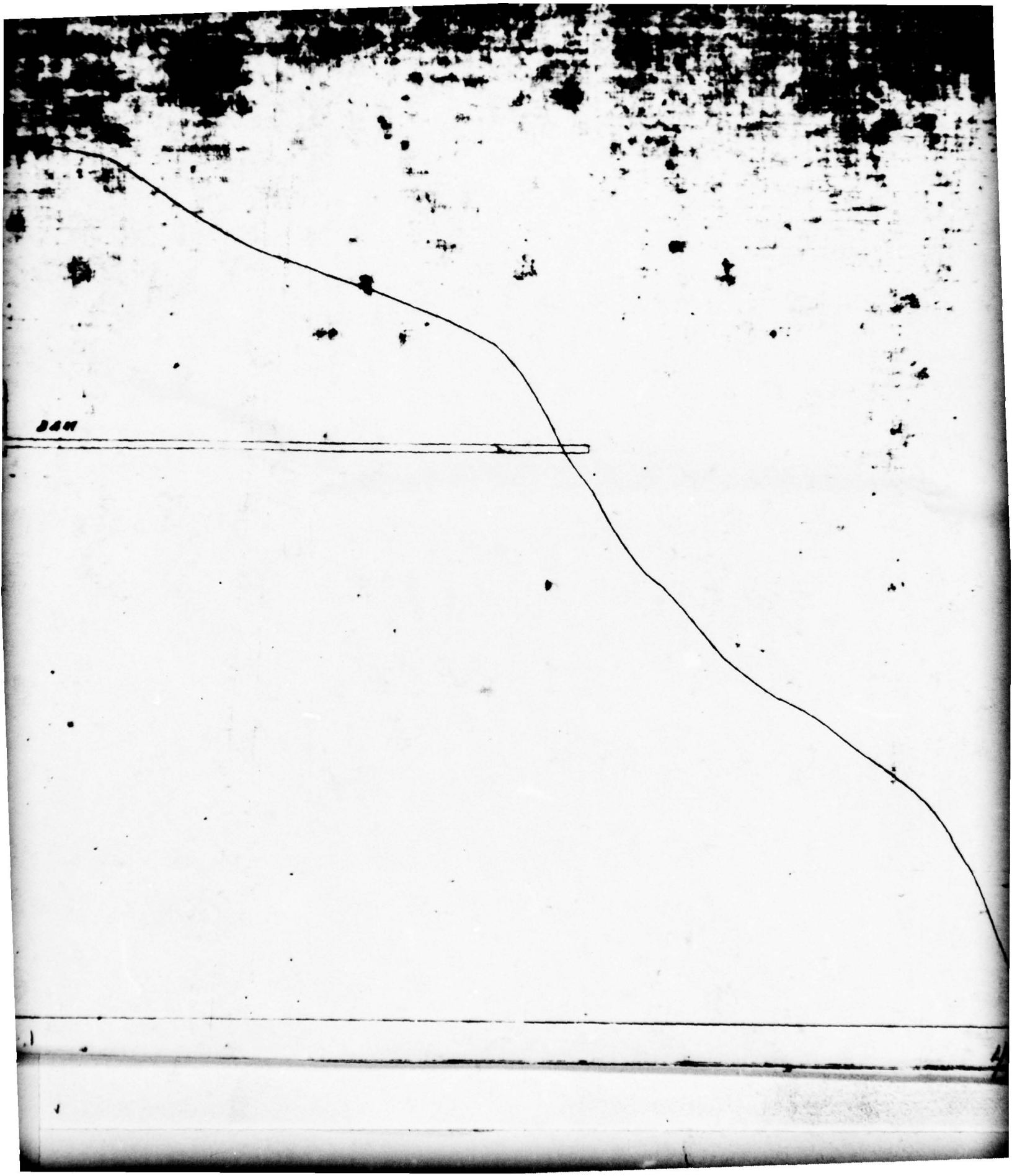


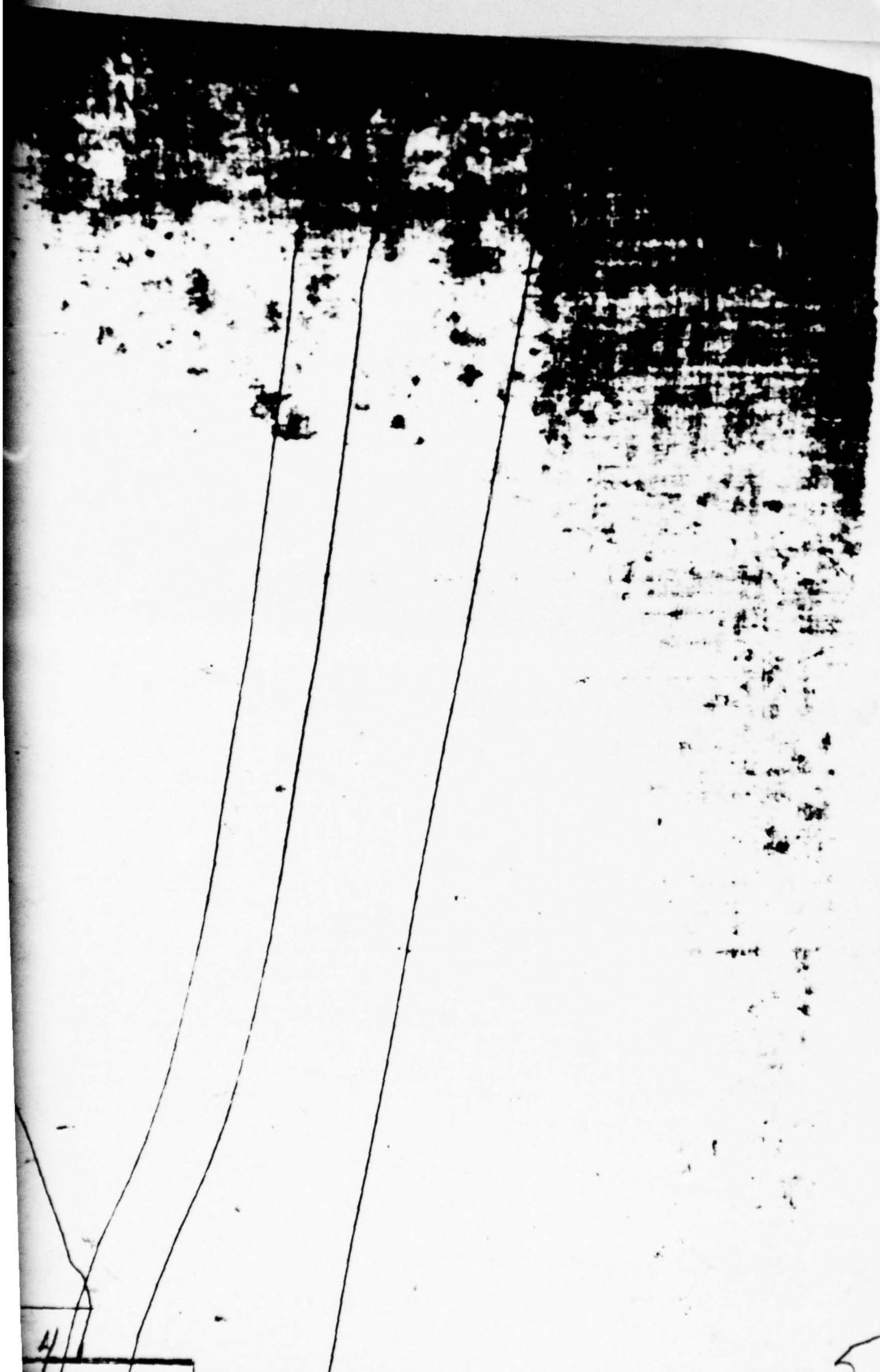
TOPOGRAPHIC MAP
AMAWALK DAM AND RESERVOIR

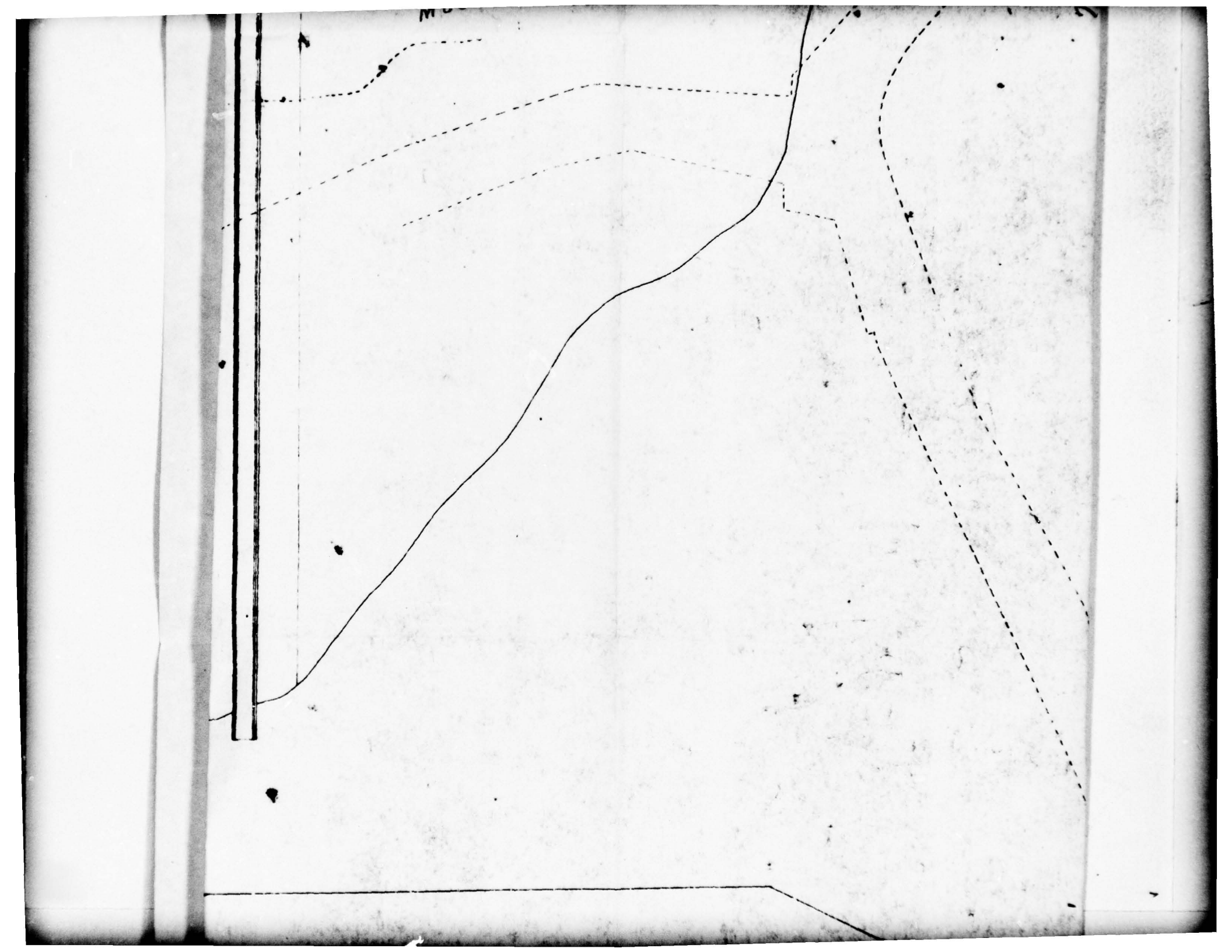


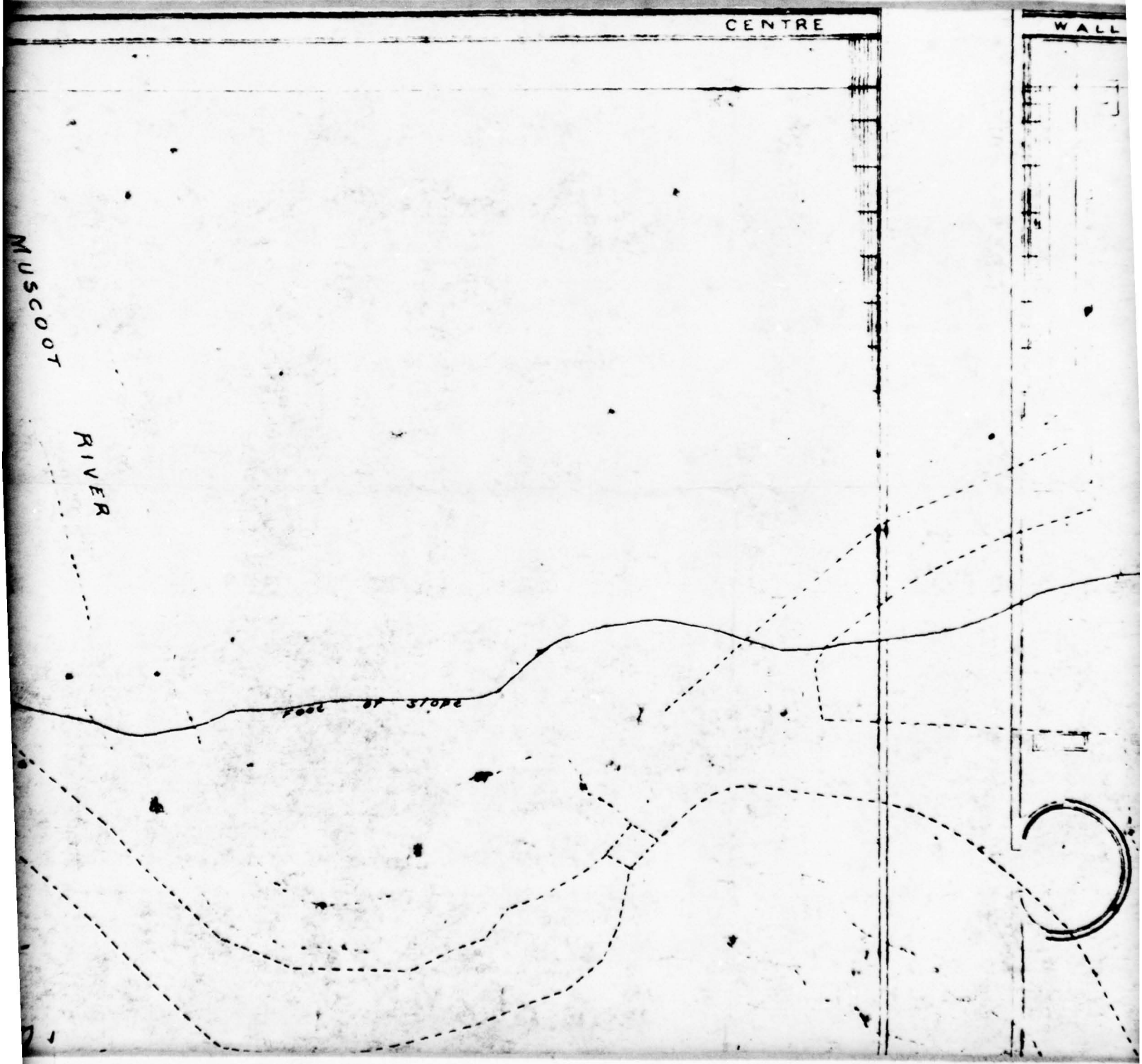


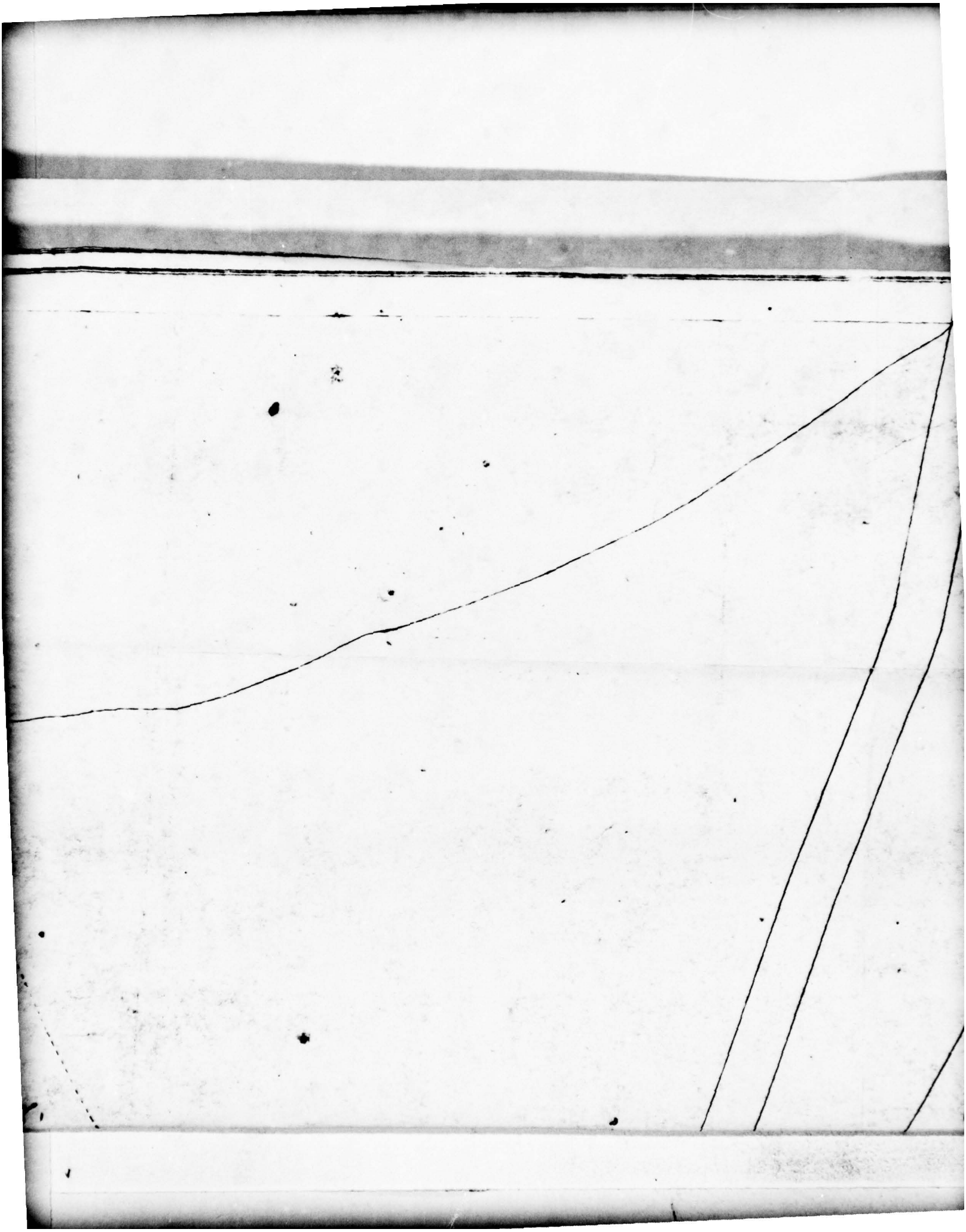

GUAR

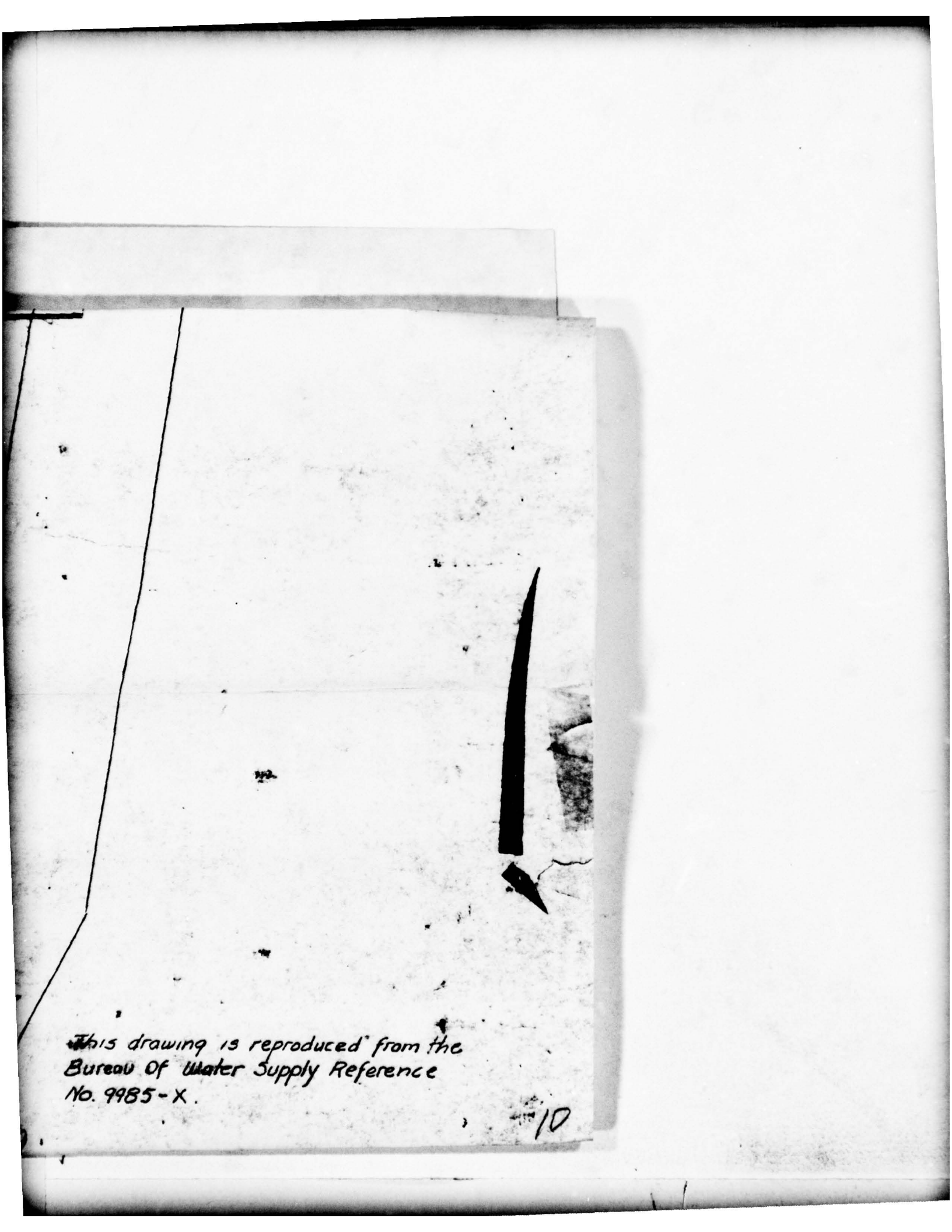

DAM


4
5

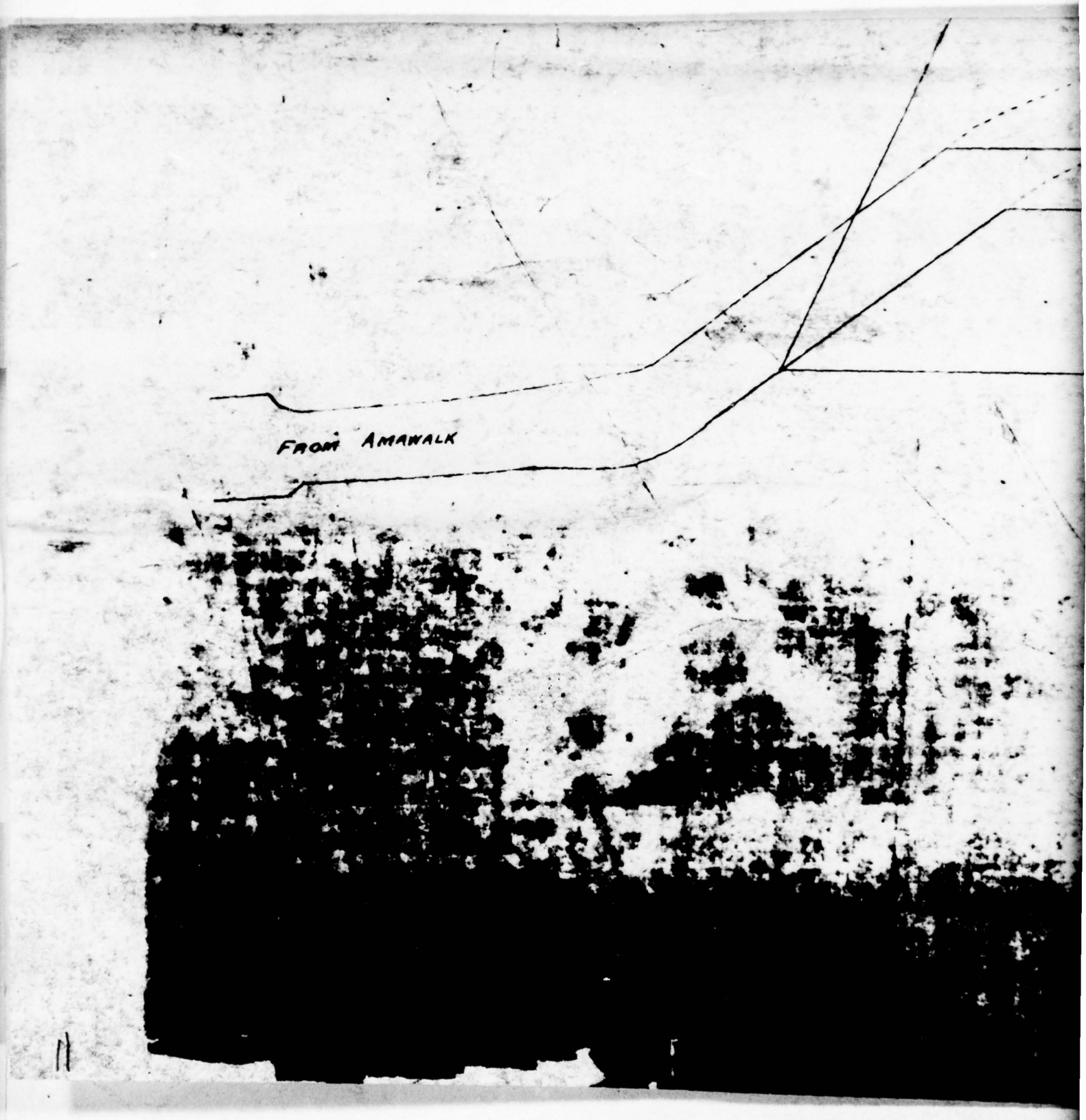


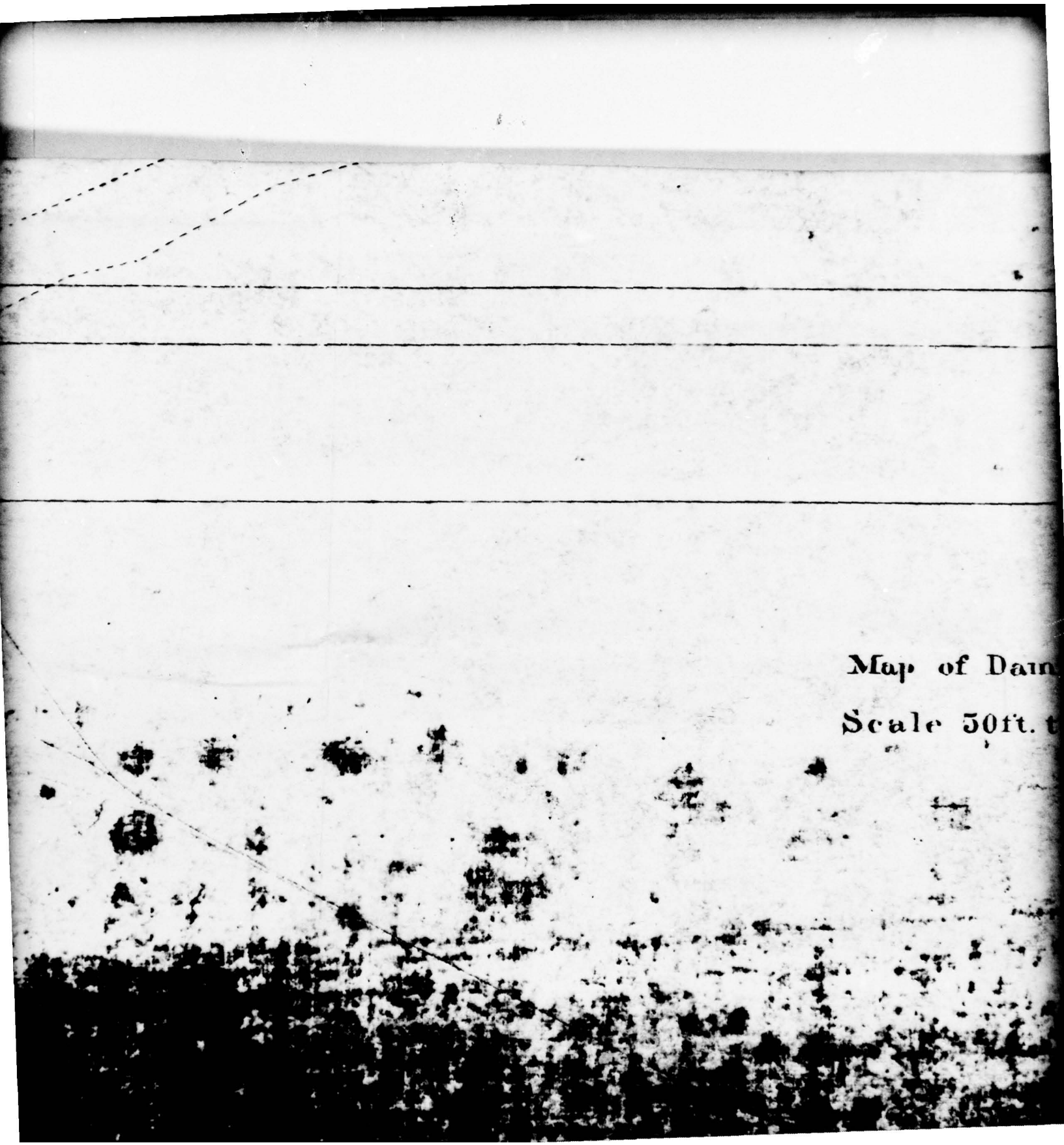

CENTRE
WALL
MUSCOOT
RIVER
FOOT OF STONE





This drawing is reproduced from the Bureau Of Water Supply Reference No. 9985-X.

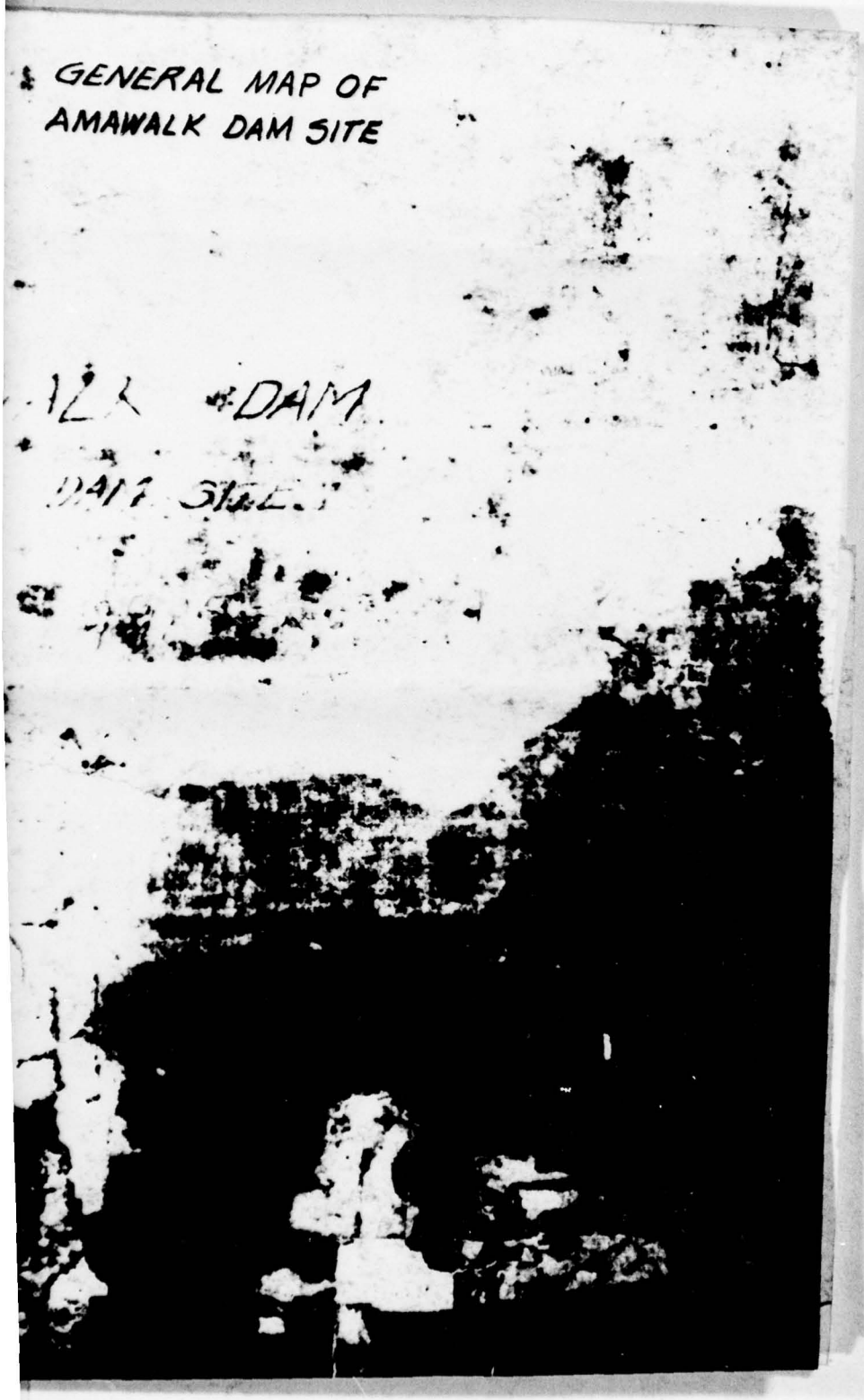

FROM AMAWALK

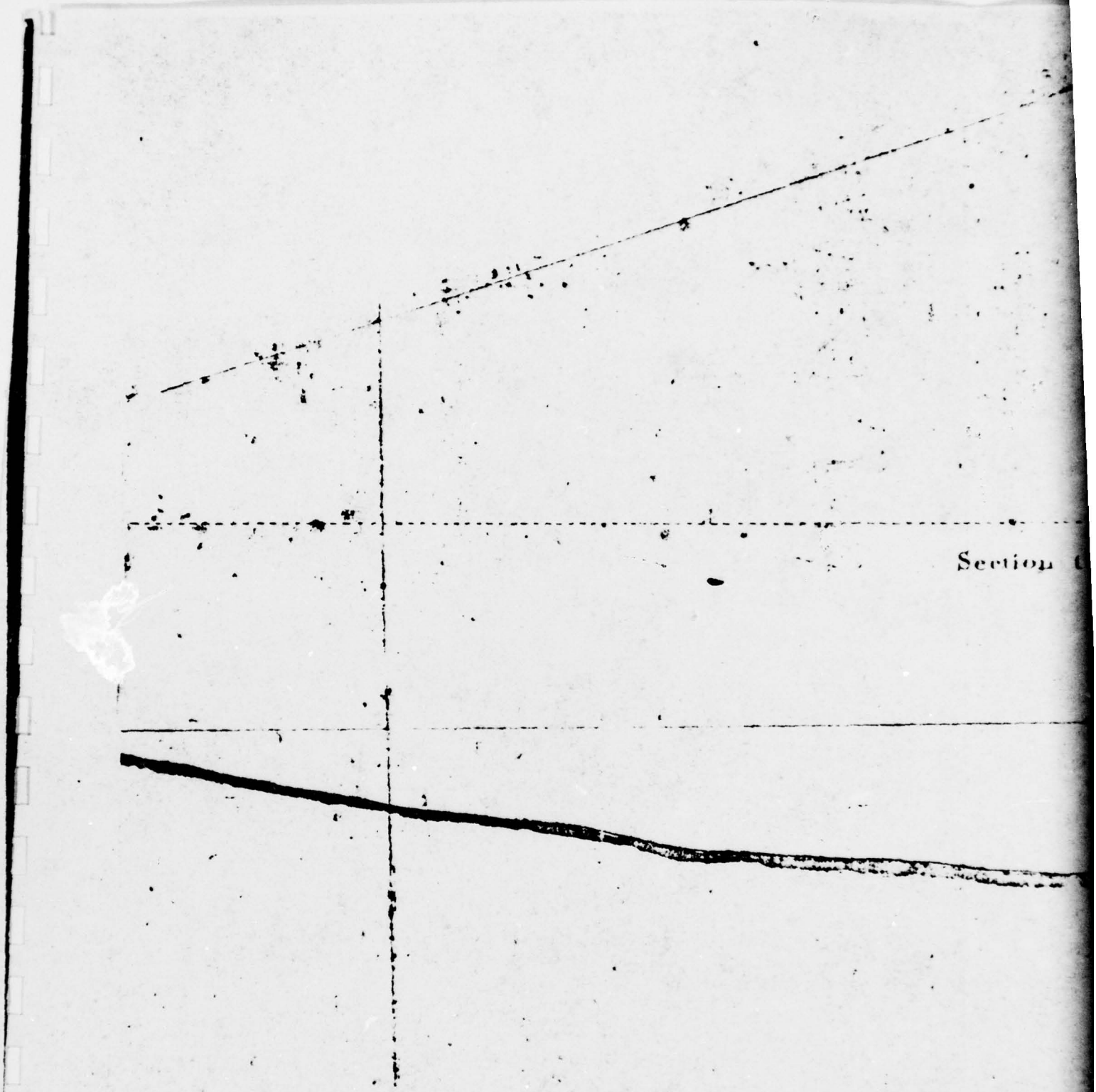

Map of Dam
Scale 50ft. t


n Site
to 1in.

PURCHASE LINE

GENERAL MAP OF
AMAWALK DAM SITE




Section

through Centre Wall and Embankment

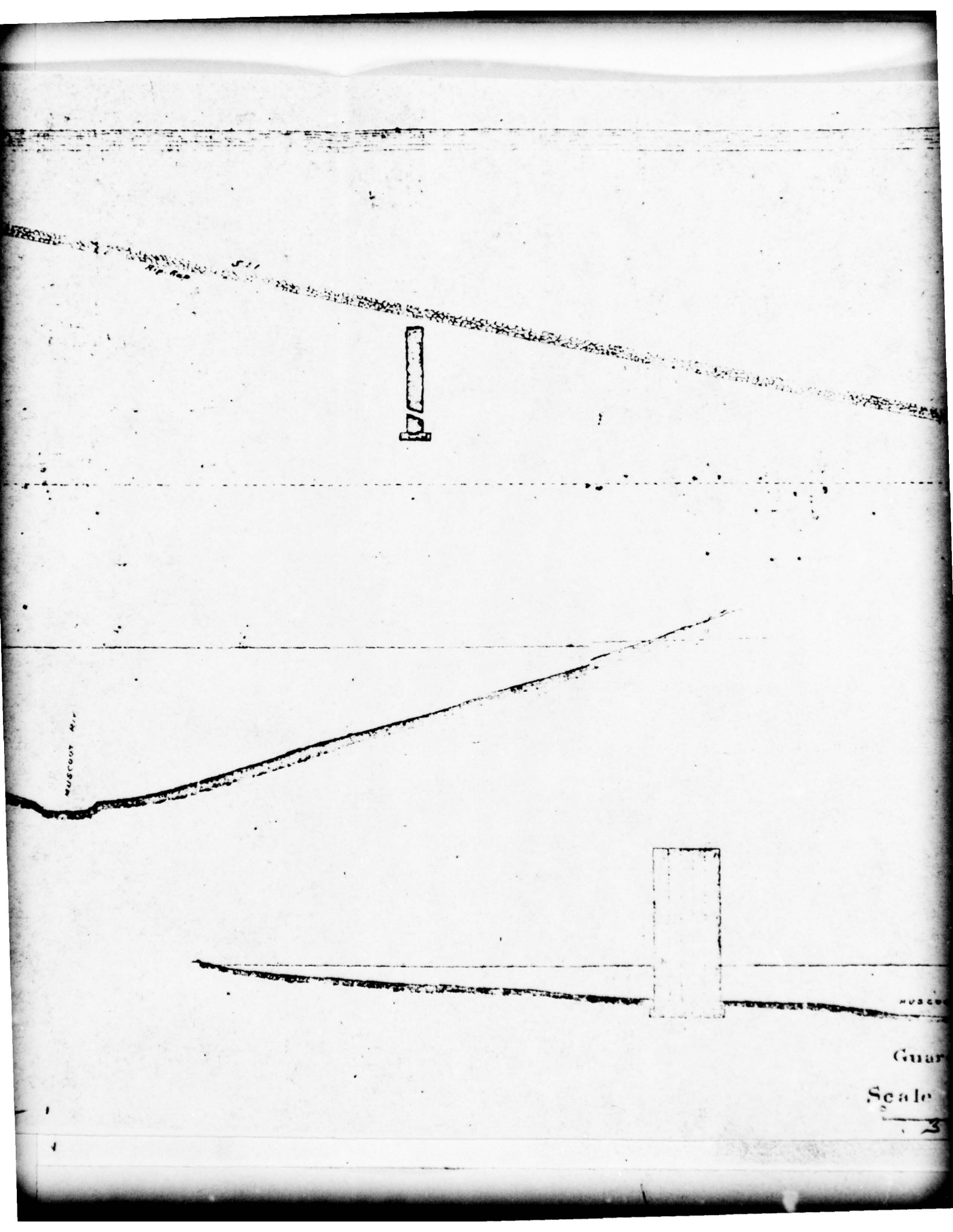
Scale 20ft. to 1in.

0 20 40

Main Dam

Scale 40ft to 1in.

0 20 40

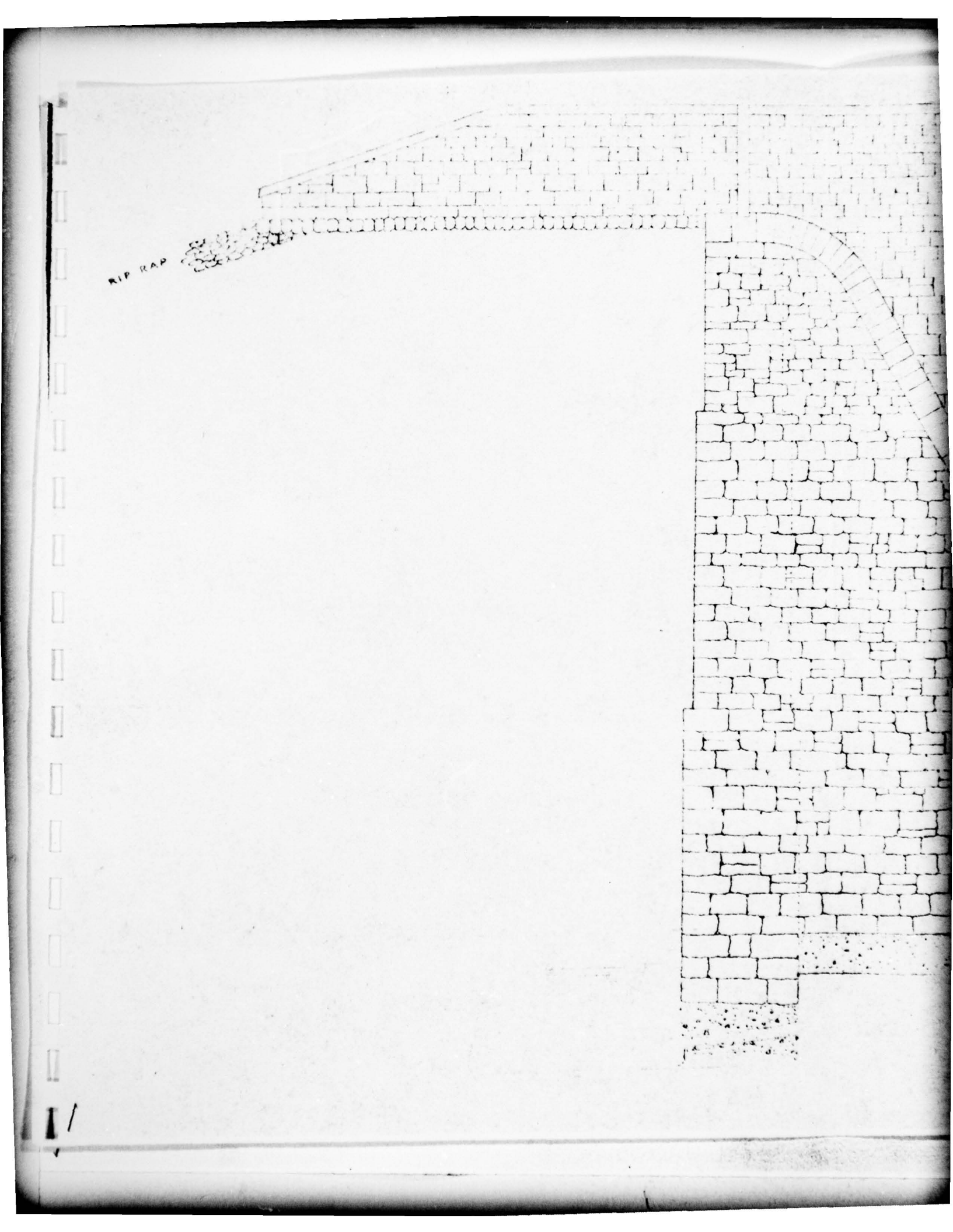

MUSCOOT RIV
Guar
Scale

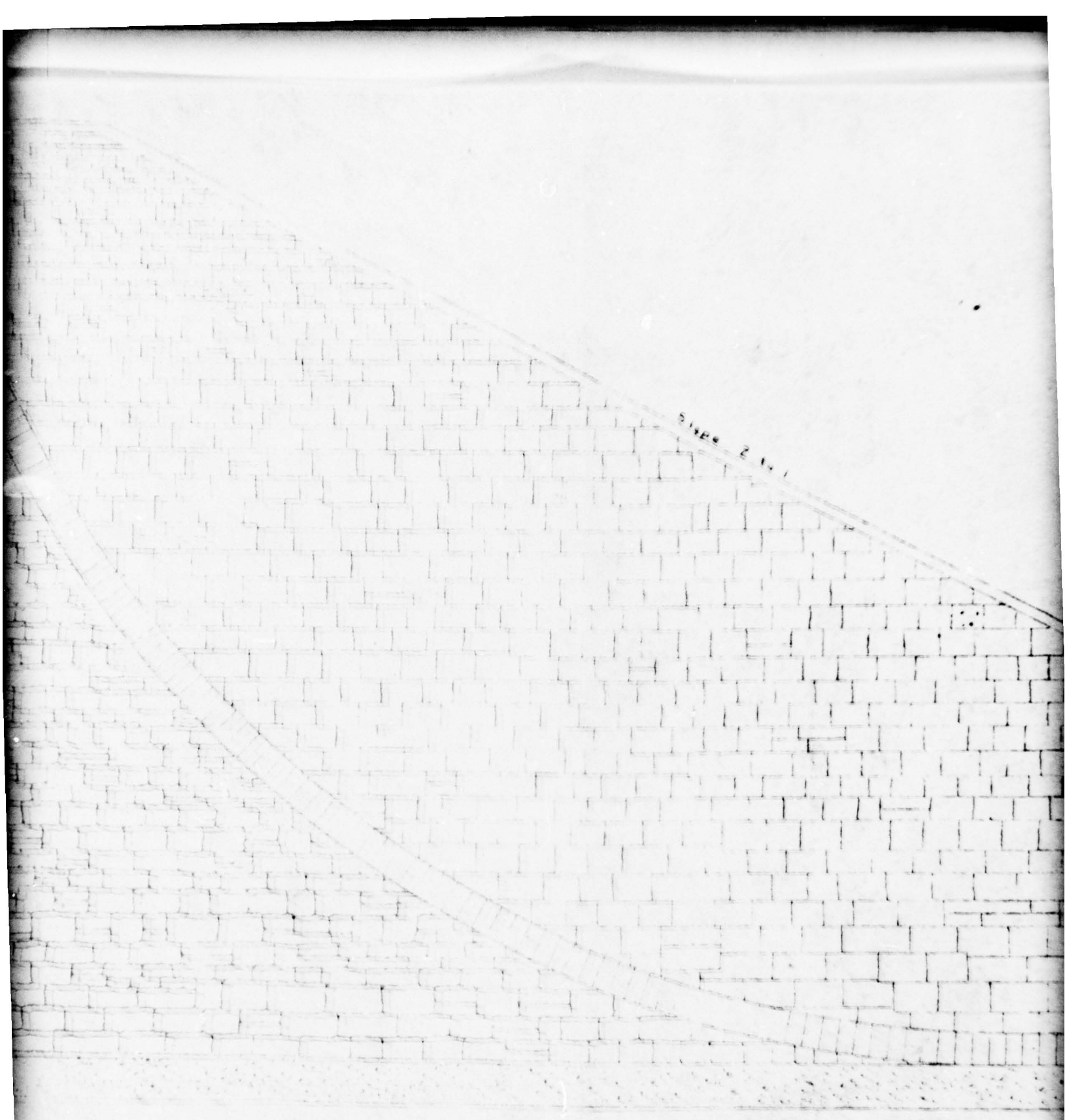
This drawing is reproduced from the Bureau of Water Supply Reference No. 9983-X

CROSS SECTIONS MAIN DAM AND GUARD DAM
AMAWALK DAM

Dam

40ft. to 1in.


RIP RAP



Elevation and Section through K L

Scale 8 ft. to 1 in.

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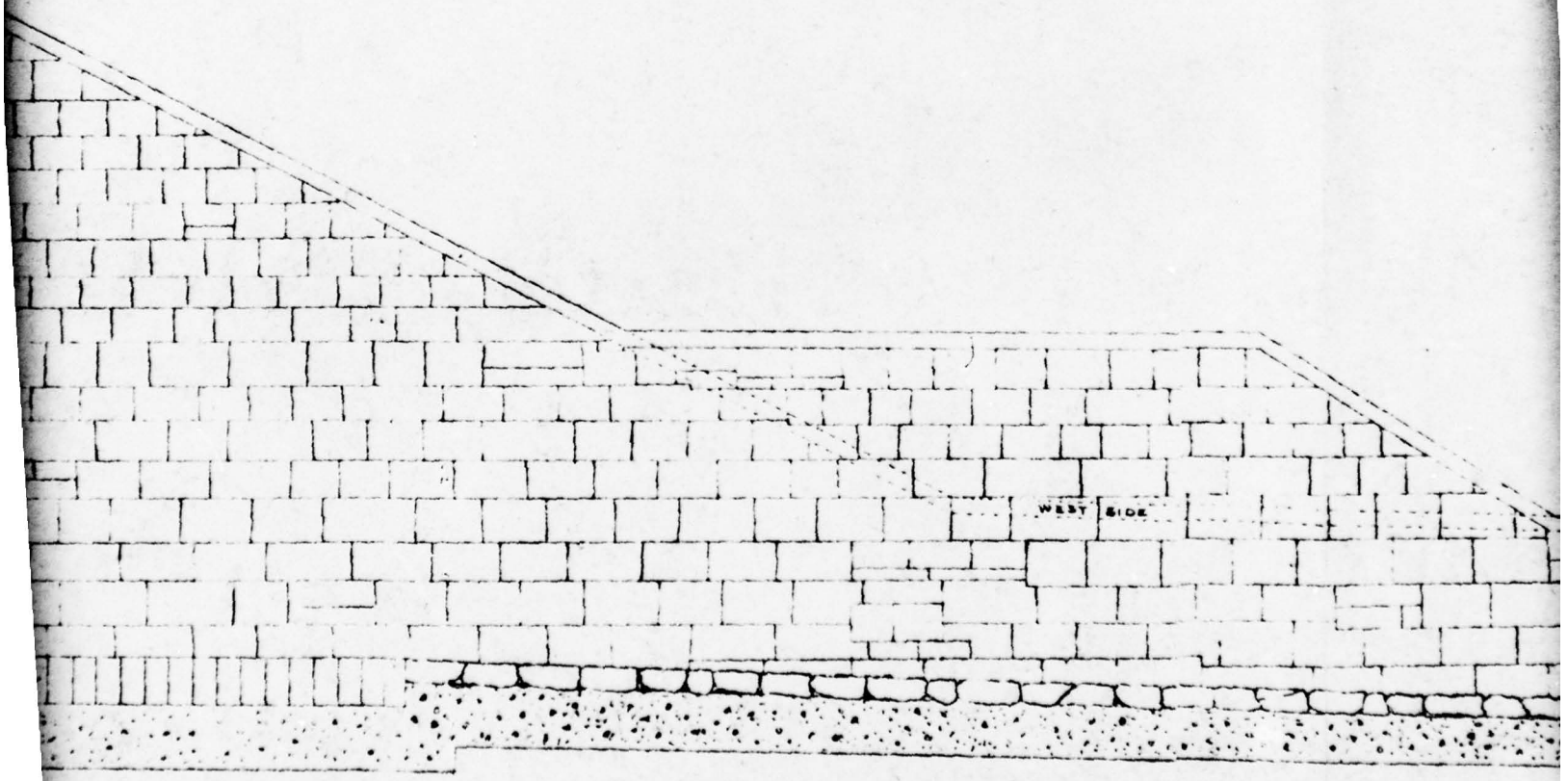

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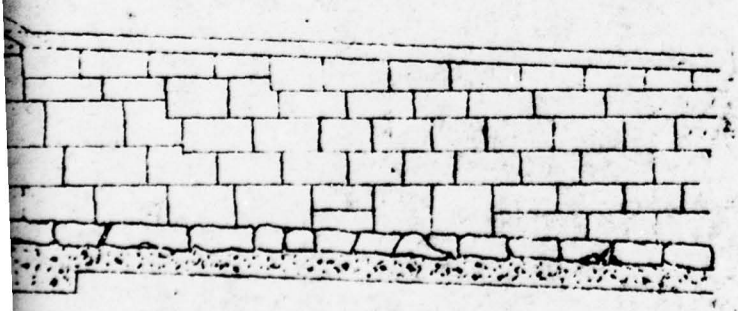
Bureau of Water Supply Ref-
nce No. 9979-X

ON ALONG SPILLWAY.
AMAWALK DAM.



3.

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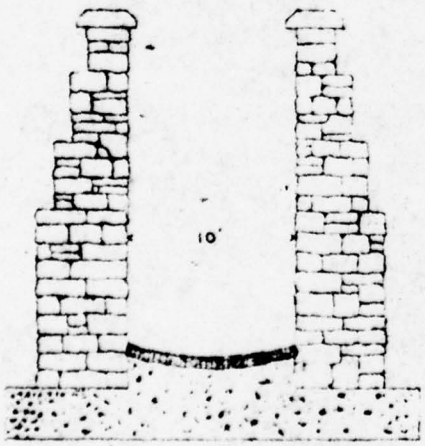
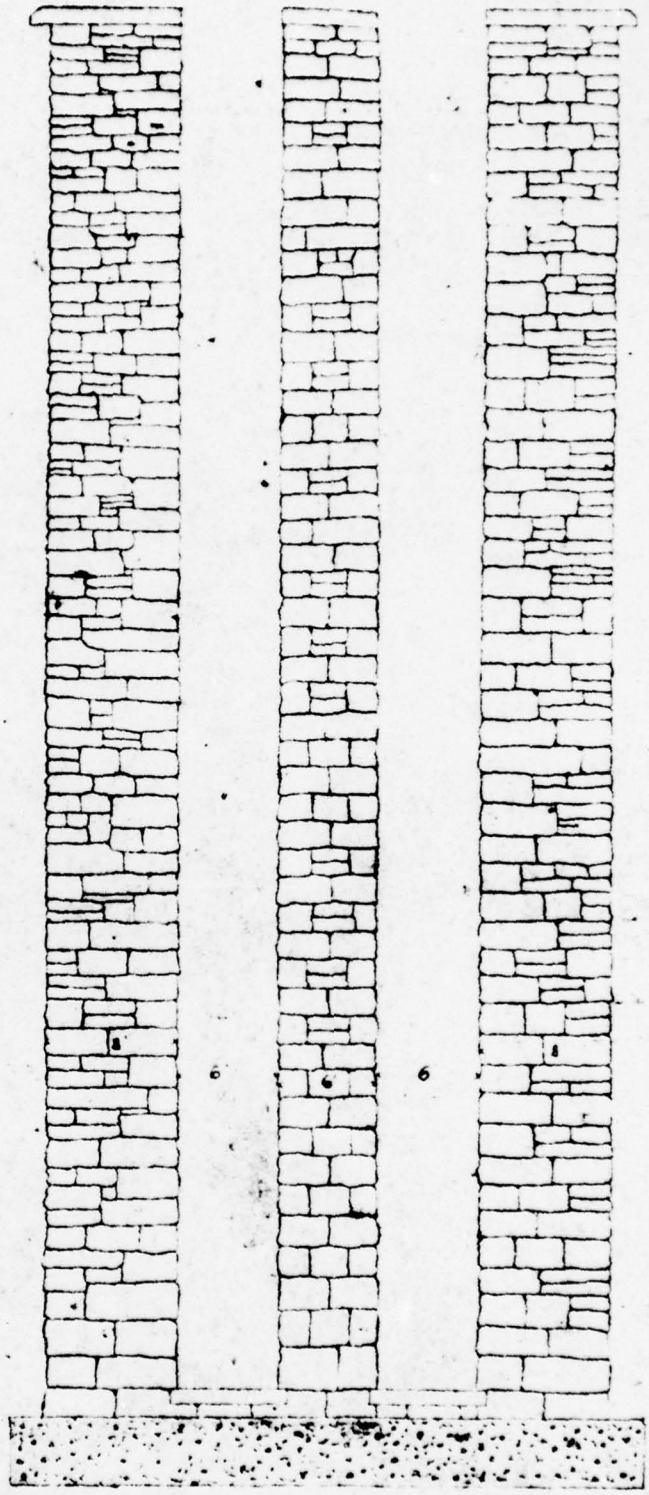
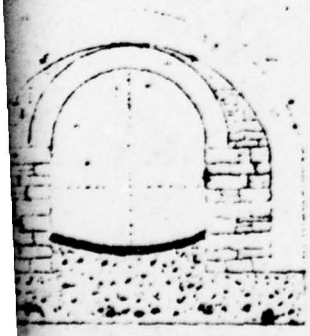


Section through AB



Section through CD

This drawing is reproduced from the Bureau of Water Supply Reference No. 9980-X



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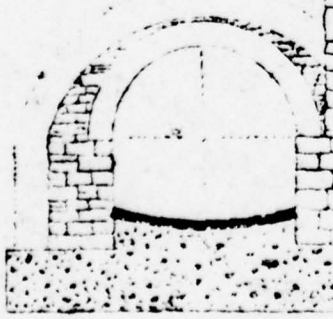

Section through GH

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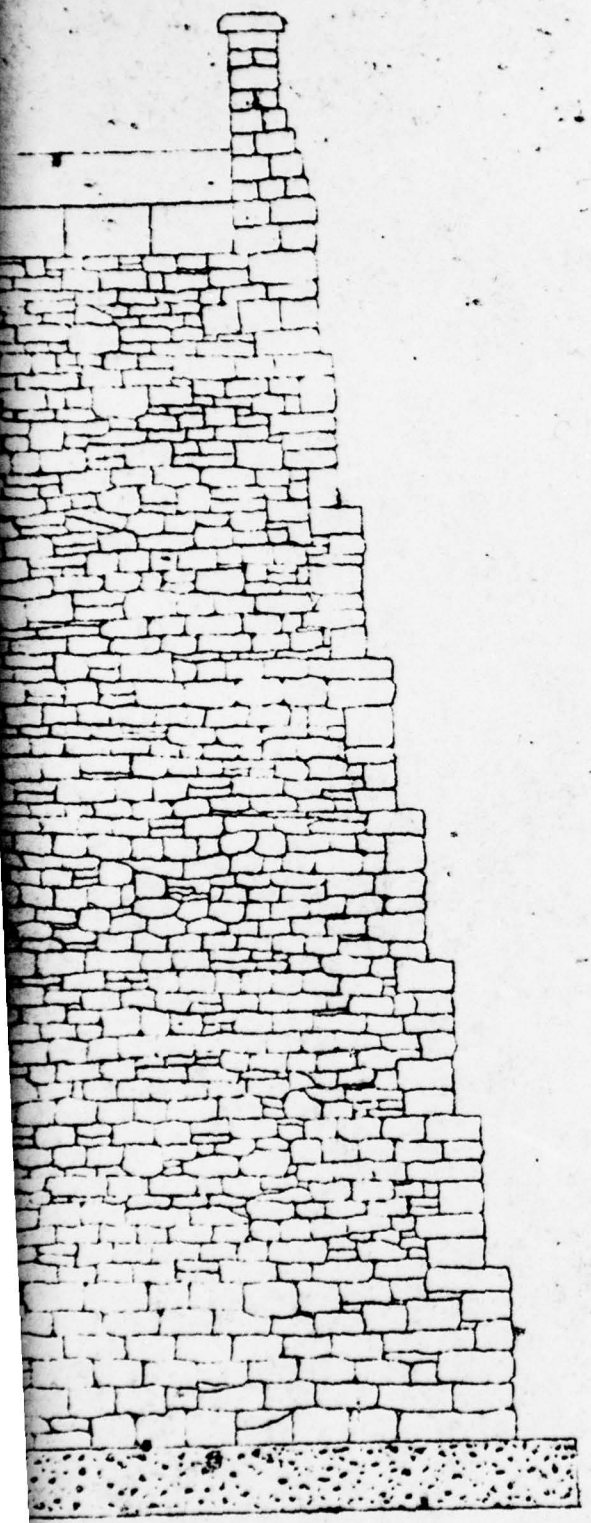
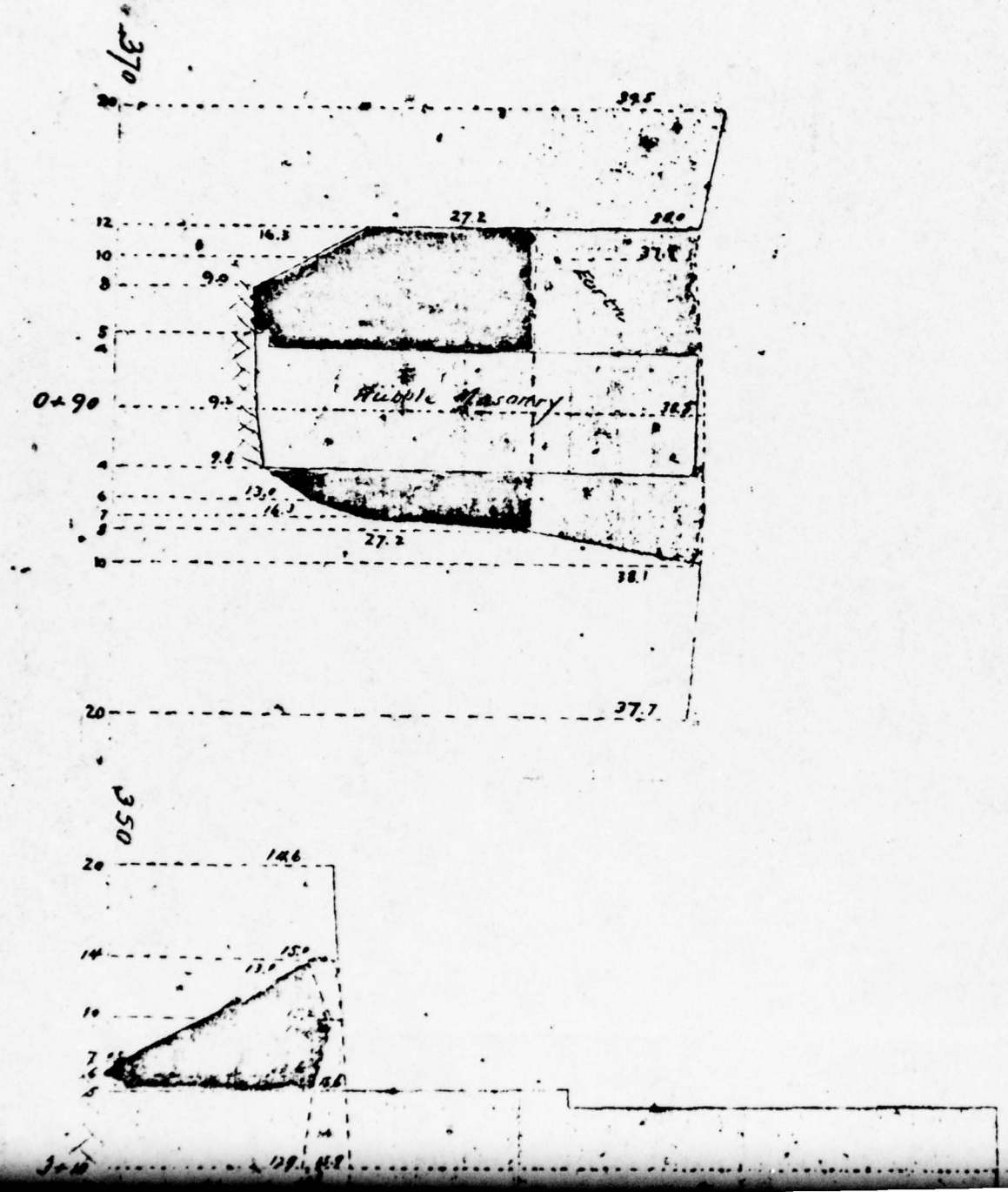
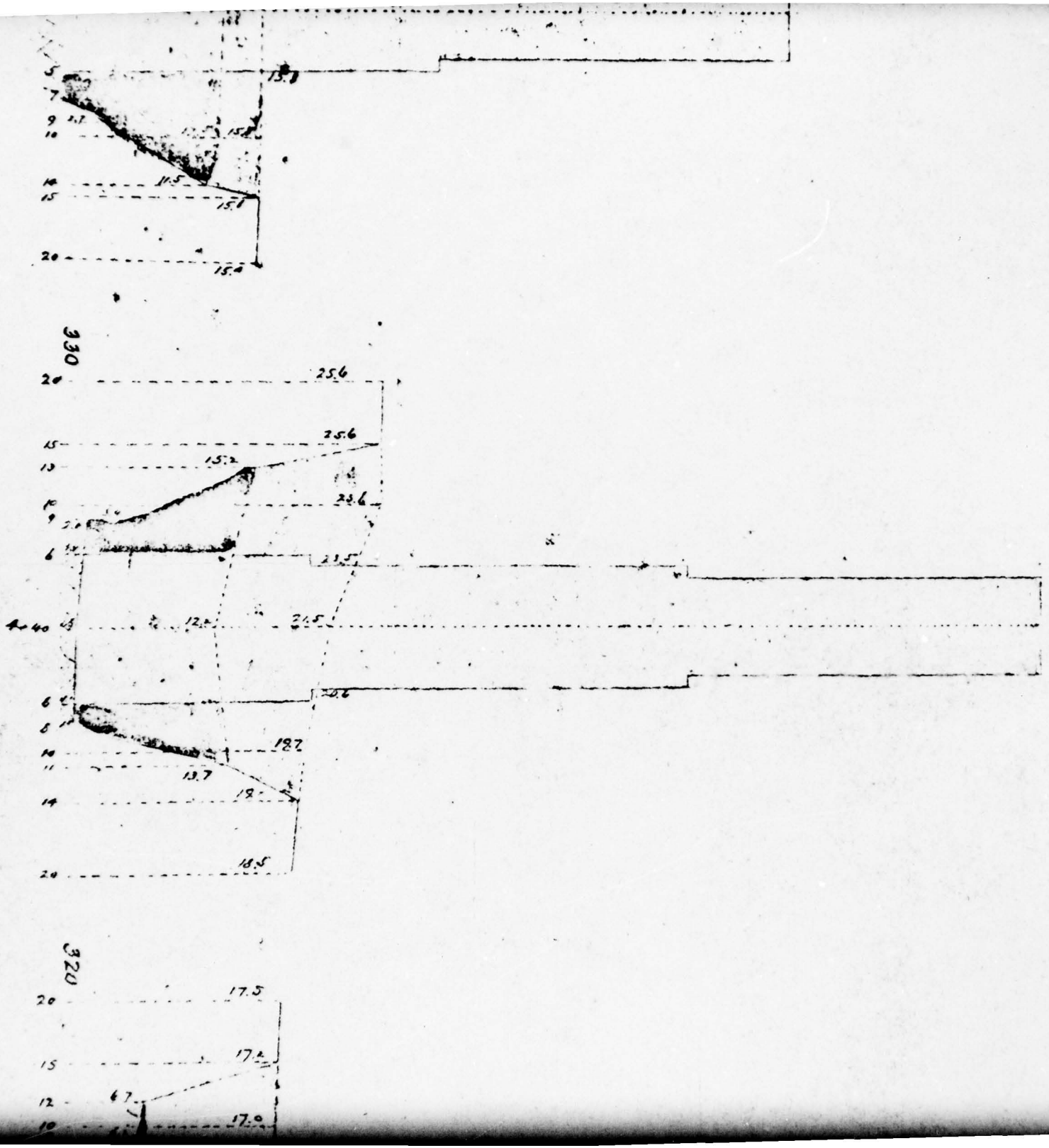
42



TIONS OF INTAKE TOWER
REAM CONDUIT & SPILLWAY
AMAWALK DAM

82.


370
39.5
12
27.2
39.0
16.3
10
37.5
8
9.0
5
4
0+90
Rubble Masonry
38.5
9.1
6
13.0
7
14.3
8
27.2
10
38.1
20
37.7
350
20
14.6
14
15.0
13.0
10
7
6
4.6
5
3+10
11.9
11.8


330
320

This dra
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SECTIONS
AMA

SCALE:
10 FT

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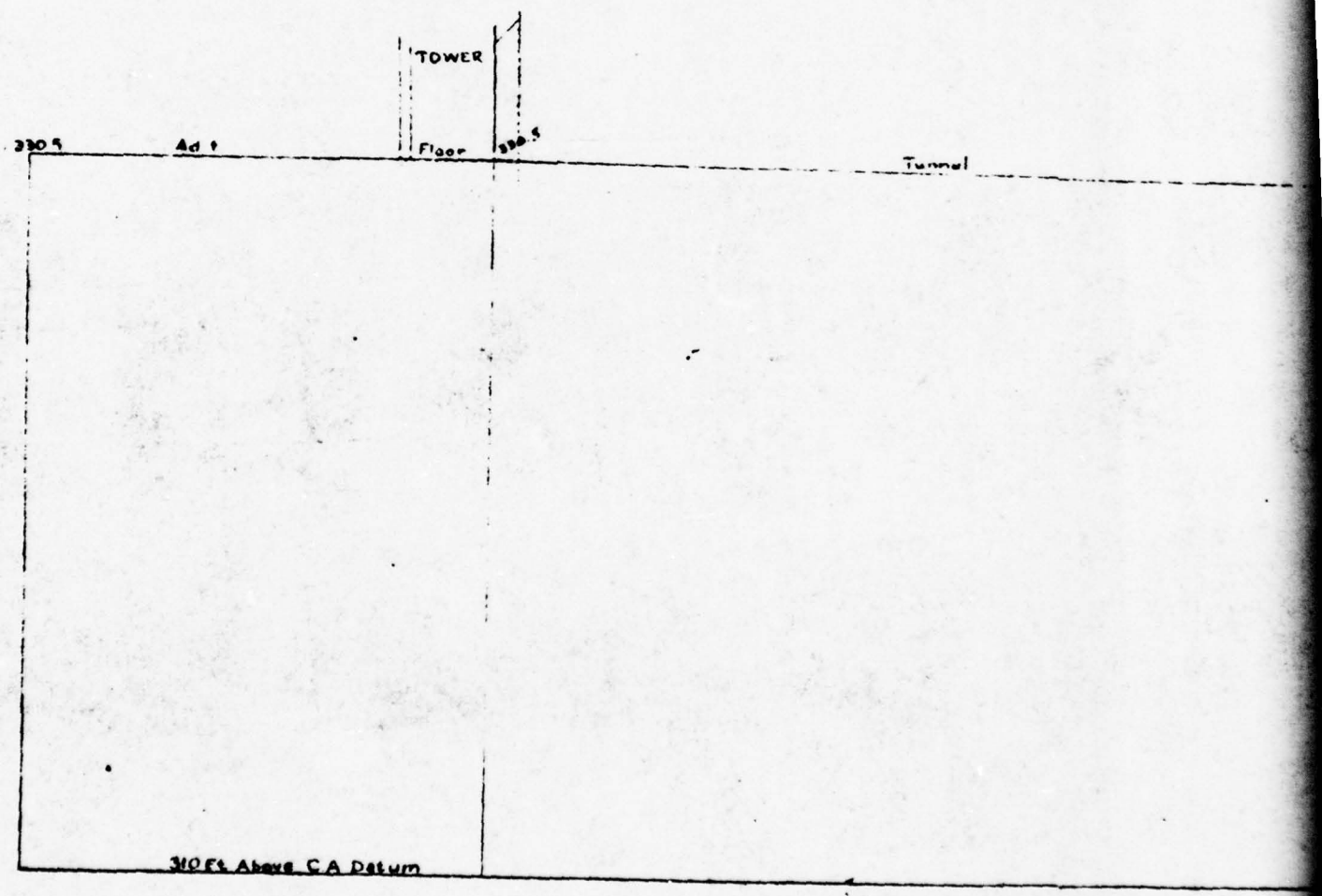
NS OF CENTER WALL
MAWALK DAM

ft to the inch
0 20

3. 4

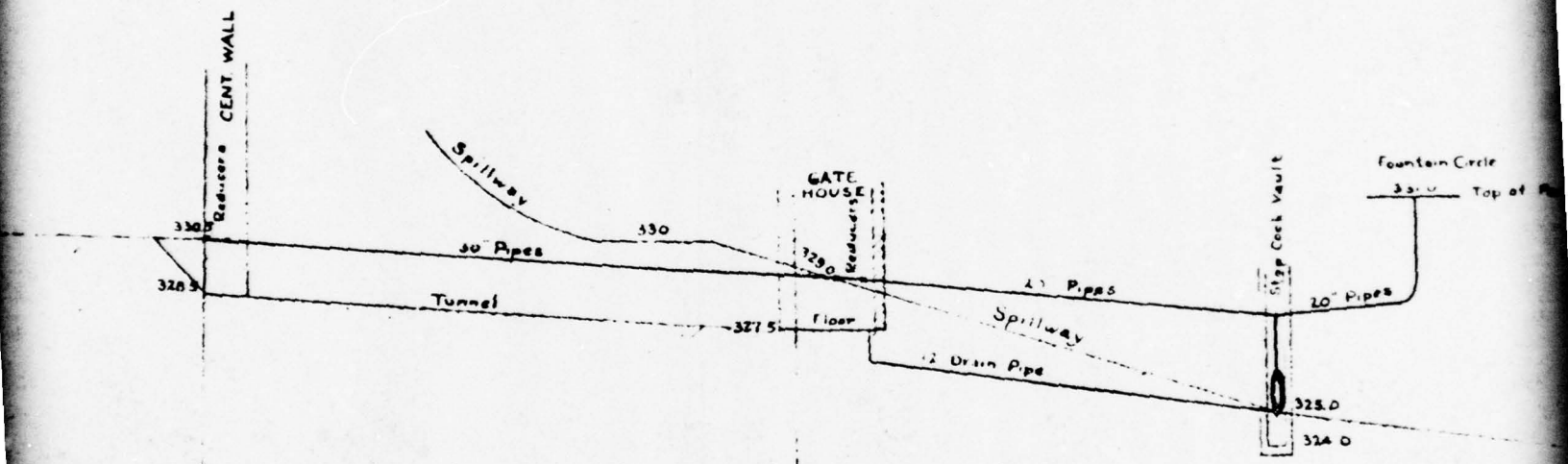

TOWER
330 ?
Adit
Floor
330.5
Tunnel
310 Ft Above C A Datum

Reservoir "A"

Profile

showing Grades of Adit, Tunnel, Spillway & Pipes

Hor Scale 40 ft per in
Vert " 4 " "

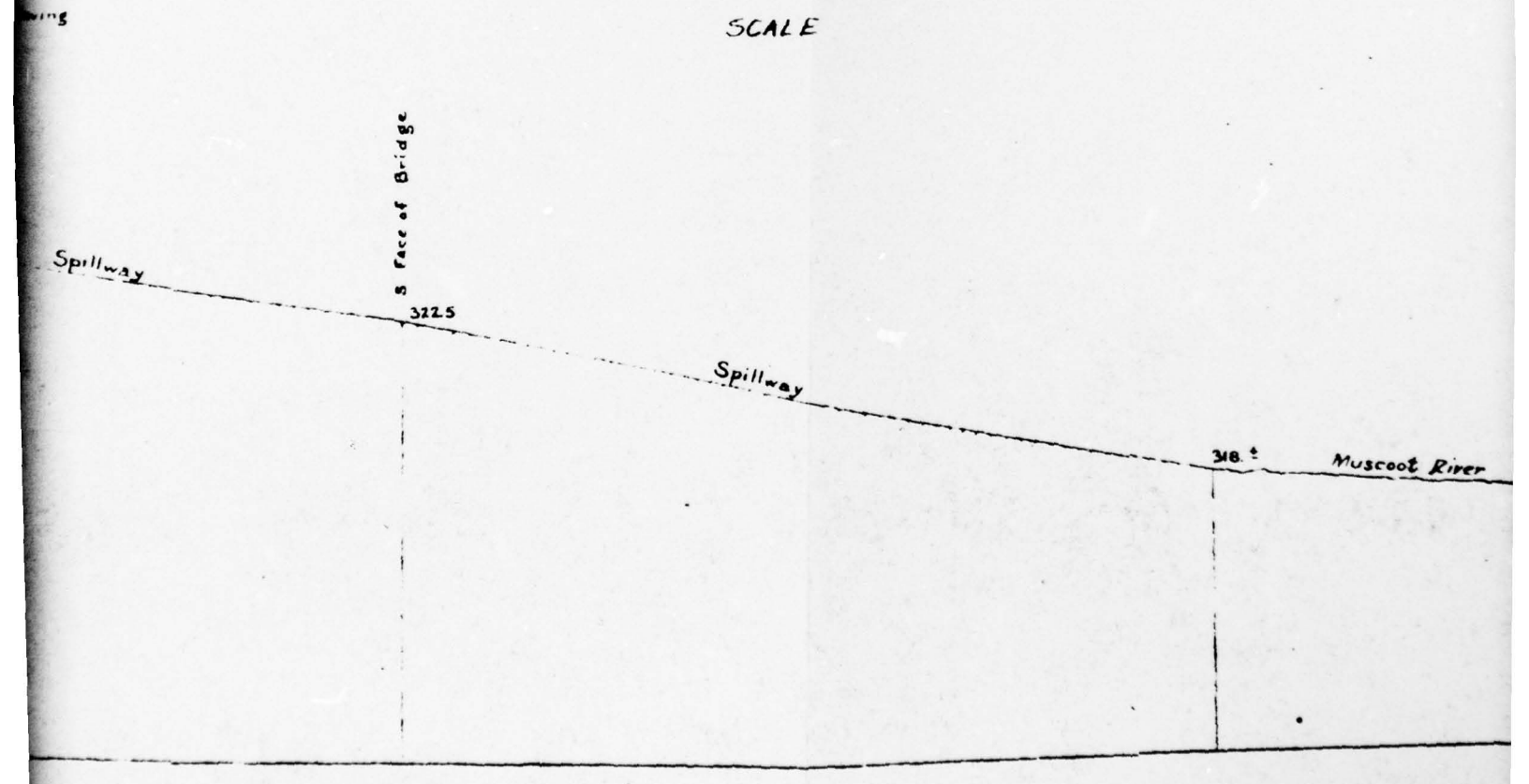


TRACING
OF
OLD ORIGINAL TRACING
BEARING IDENTICAL FILE NO.
OCTOBER 1, 1942.

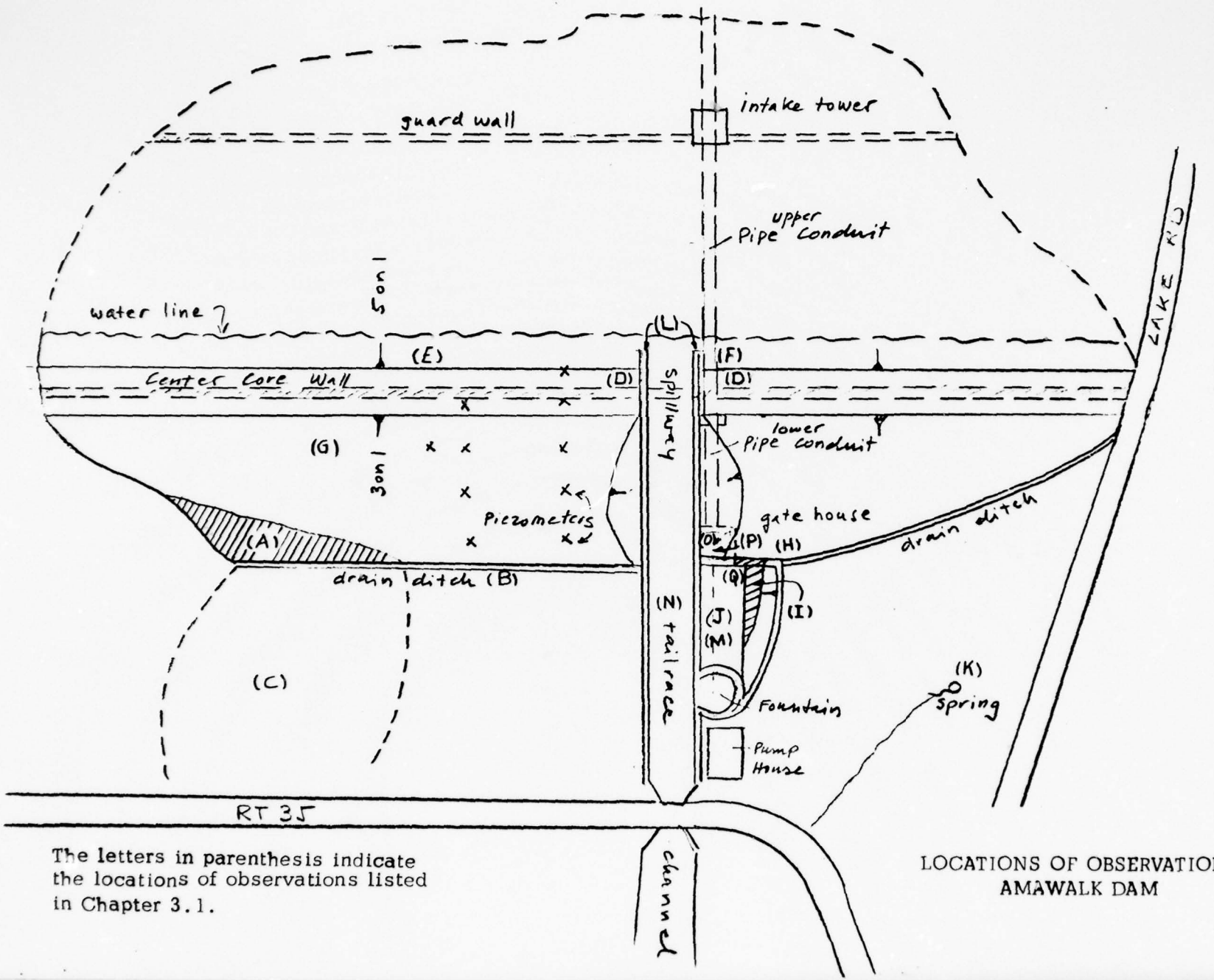
This drawing is reproduced from the Bureau of Water Supply Reference No. 9978-X

Horizontal 0 40 80
Vertical 0 4 8

SCALE



AMAWALK DAM



The letters in parenthesis indicate the locations of observations listed in Chapter 3.1.

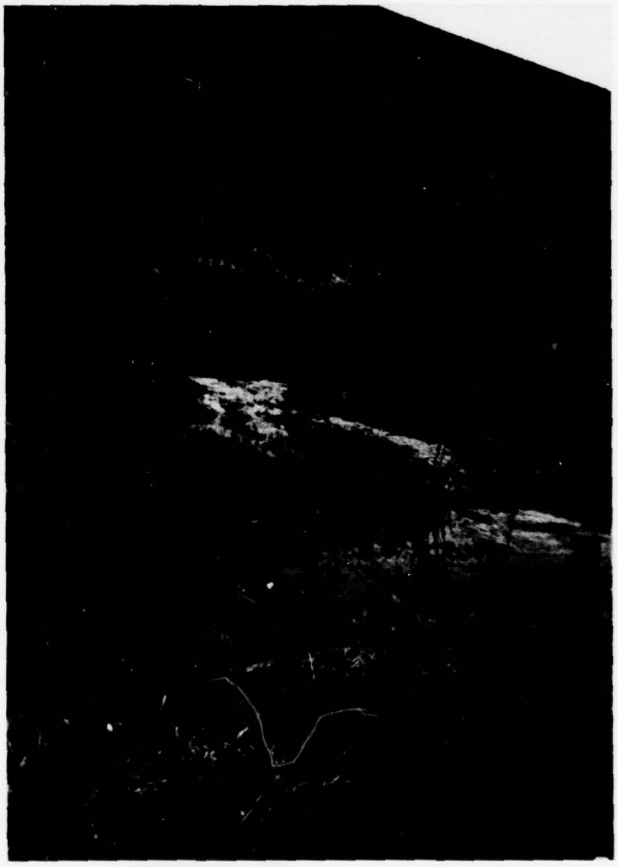
LOCATIONS OF OBSERVATIONS
AMAWALK DAM

PHOTOGRAPHS

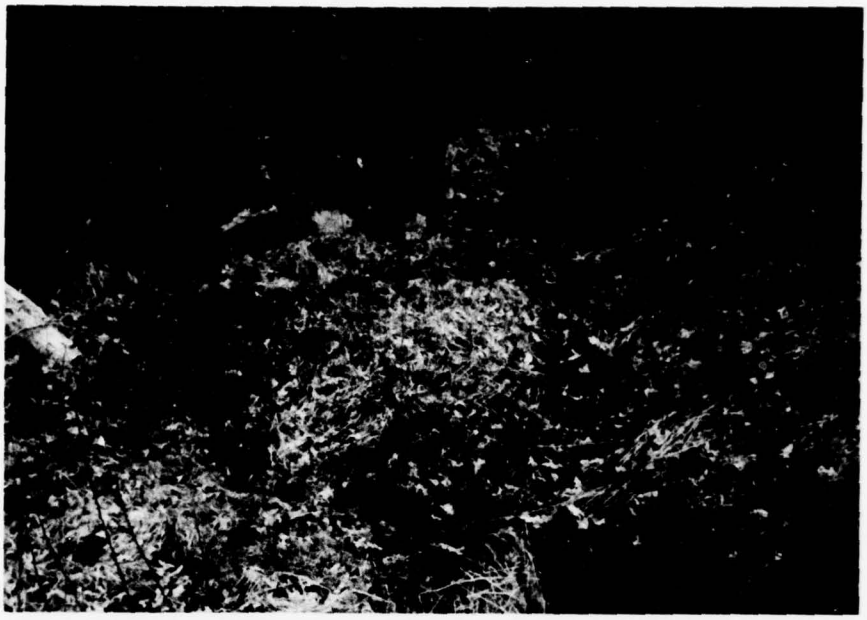
APPENDIX B

LEFT ABUTMENT AREA WHERE SEEPAGE HAS BEEN NOTED
[OBSERVATIONS (A), (B) AND (C)]

DOWNSTREAM SLOPE, TOE DITCH, RIGHT ABUTMENT CONTACT
SHOWING THE AREA OF SEEPAGE [OBSERVATIONS (A), (B) AND (C)]

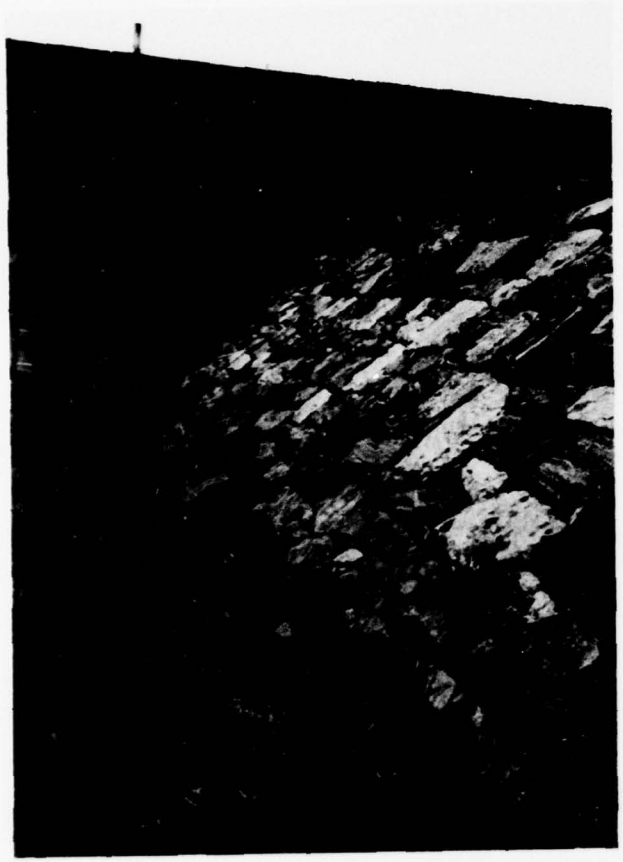


SEEPAGE FROM DOWNSTREAM SLOPE [OBSERVATION (A)]

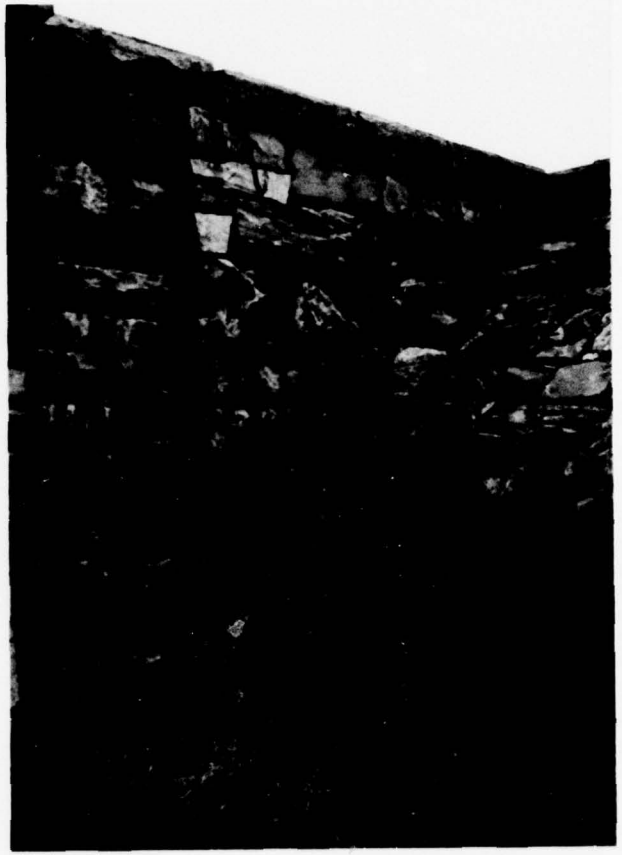


SEEPAGE AT RIGHT ABUTMENT CONTACT [OBSERVATION (A)]

SPILLWAY AND GATEHOUSE



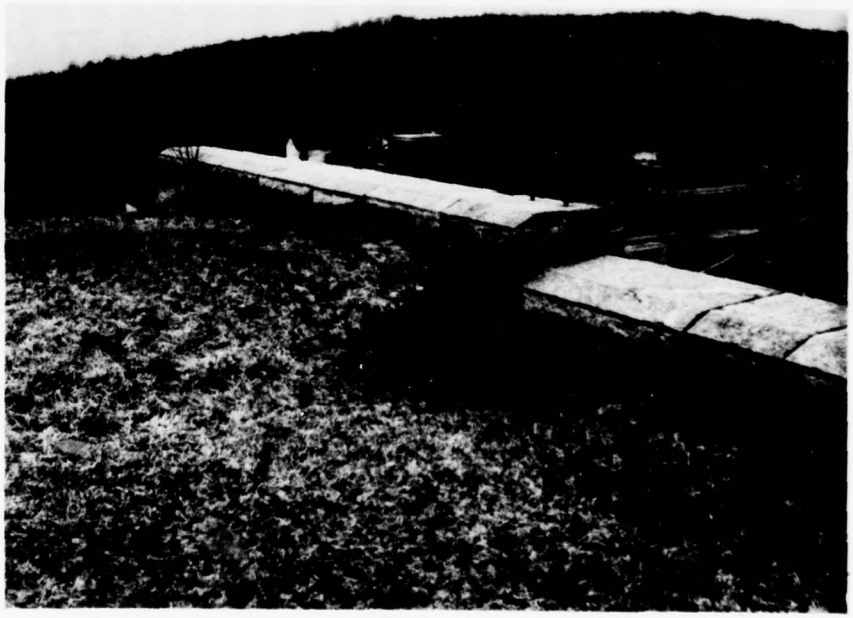
SEEPAGE DOWNSTREAM OF GATEHOUSE
[OBSERVATION (I)]



DISLOCATED WALL [OBSERVATION (Q)]

DETAIL OF WALL JOINT LEFT OF GATEHOUSE WHERE MOVEMENT AND SEEPAGE WAS NOTED. [OBSERVATIONS (I) AND (Q)]

CREST OF EMBANKMENT, UPSTREAM SLOPE PROTECTION AND INTAKE TOWER



EROSION ON CREST AT SPILLWAY WALL [OBSERVATION (D)]
(THE STEP IN THE WALL IS NOT MOVEMENT)

RIP-RAP AND SPILLWAY WALL DAMAGES [OBSERVATIONS (F) AND (L)]

UPSTREAM SLOPE OF AUXILIARY EMBANKMENT

ENGINEERING DATA CHECKLIST

APPENDIX C

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Amawalk #1

ID # 45

ITEM	REMARKS
AS-BUILT DRAWINGS	
✓	SEE DRAWING LIST
REGIONAL VICINITY MAP	
	USGS maps: Mohegan Lake, Croton Falls, Oscawana Lake, Lake Carmel quadrangles. - 7.5 minute series 1:24000
CONSTRUCTION HISTORY	
	Contractor: John MC Quade - Year of completion: 1897 No other data available.
TYPICAL SECTIONS OF DAM	
✓	SEE DRAWING LIST
OUTLETS-PLAN	
✓	
-DETAILS	
✓	
-CONSTRAINTS	
-DISCHARGE RATINGS	
RAINFALL/RESERVOIR RECORDS	
	Data available in the Hartford District office of the BOWS.

ITEM	REMARKS
DESIGN REPORTS	None
GEOLOGY REPORTS	Reports on regional geology only
DESIGN COMPUTATIONS	None
HYDROLOGY & HYDRAULICS	
DAM STABILITY	None
SEEPAGE STUDIES	Visual observations by Section Engr. Some data in USBR Tech Mem 329 (1934)
MATERIALS INVESTIGATIONS	No Data Available
BORING RECORDS	
LABORATORY	
FIELD	
POST-CONSTRUCTION SURVEYS OF DAM	No data
BORROW SOURCES	No data.

ITEM	REMARKS
MONITORING SYSTEMS	11 standpipe piezometers in the early 1920's. They are inoperative
MODIFICATIONS	None recorded
HIGH POOL RECORDS	Available in Ketrack Office of BOWS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Seepage studies reported in USBR TM 389. (1934)
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None recorded
MAINTENANCE OPERATION RECORDS	Record kept in Ketrack Office of BOWS.

ITEM	REMARKS
SPILLWAY PLAN	SEE DRAWING LIST
SECTIONS	
DETAILS	
OPERATING EQUIPMENT	Some data shown on the
PLANS & DETAILS	available drawings.

VISUAL INSPECTION CHECKLIST

APPENDIX D

VISUAL INSPECTION CHECKLIST

1. Basic Data

a. General

Name of Dam Amawalk * Hazard Category _____

County Westchester ID# 45

Stream Name Muscoot Tributary of Croton

Location Westchester County Nearest Town (P.O.) Somers Amawalk NY

Longitude 41° 17' 17" Latitude 73° 45' 49" Other Directions _____

on Rt. 35 between Katonah and Amawalk

Date of Insp Apr. 27, 78 Weather Coludy Temperature 45°F

b. Inspection Personnel Kalmon Szalay

Harold Leventhal

Mike Gazit

c. Persons Contacted Carl A Picha - Division Engineer

City of New York, Dept of Water Resources

John Byrnes - Section Engineer

d. History: Date Constructed 1897

Present Owner City of New York

Designed by Dept of Public Works City of NY

Constructed by John McQuade

Recent History _____

2. Technical Data

Type of Dam Earth fill with masonry core Drainage Area 19.15 sq. mi.

Height 82 FT Length 1270 FT

Upstream Slope 1 on 5 Downstream Slope 1 on 3

Crest Width 55 Freeboard ~~at~~ over Spillway Crest 10 ft

Crest of Spillway EL. 399.55

EL. of outlet EL. 354.6

* There is also a small auxiliary dam near US Route 202

Low Level Control: (Type and Size) 20 inch and 30 inch diameter gate valves

Valve Condition Fair

~~Emergency~~ Spillway Type (Material) Masonry finished with face stones Width 50 ft

Side Slopes See Dwgs. 9979x & 9930x

Height (Crest to Top) " "

Exit Slope " "

Exit Length " "

Ponded Surface Area 60 ± (Spillway level) Acres

Capacity (Normal Level) 6·692 (Spillway crest) ~~Acre~~ Feet

Capacity Emergency Spillway Level ___ Acre Feet

3. Embankment (Flashboards no longer used on spillway crest after floods of 1955)

a. Crest

(1) Vertical Alignment No apparent deformation

(2) Horizontal Alignment Same

(3) Longitudinal Surface Cracks None evident

(4) Transverse Surface Cracks Same

(5) General Condition of Surface Grassed with trees

(6) Miscellaneous There is a 12 ft wide section at the center of the crest which is elevated about 2 ft above the remainder of the 55 ft wide crest. This portion seems to coincide with the center masonry core well.

b. Upstream Slope About 20 ft near crest covered with grass; below this rip rapped.

(1) Undesirable Growth or Debris Some bushes and small trees

(2) Sloughing, Subsidence, or Depressions Minor depression near left spillway wall. Appears to be wave damage.

(3) Slope Protection Rip-rap - mica schist and gneiss; stones generally smaller than 10 in.

(a) Condition of Riprap Somewhat deteriorated but no major damage

(b) Durability of Individual Stones Numerous weathered pieces.

(c) Adequacy of Slope Protection Against Waves and Runoff Face of riprap appears to be small but no major damage is evident.

(d) Gradation of Slope Protection - Localized Areas of Fine Material Well graded riprap uniformly distributed over entire area

(4) Surface Cracks None

c. Downstream Slope

(1) Undesirable Growth or Debris Well maintained grass cover some bushes where surface is wet and could have not mowed by tractor.

(2) Sloughing, Subsidence, or Depressions; Abnormal Bulges or Non-Uniformity

some irregularities - possibly tractor marks - near right abutment where surface is wet. Depressions above gate chamber on left side of slope

(3) Surface Cracks on Face of Slope

None. There are some animal burrows, about ϕ 8 inch on the surface (woodchuck?)

(4) Surface Cracks or Evidence of Heaving at Embankment Toe

None

(5) Wet of Saturated Areas or Other Evidence of Seepage on Face of Slope; Evidence of "Piping" or "Boils"

Wet area near left abutment - boils at toe in the same area.

(6) Fill Contact with Outlet Structure

Surface drainage inadequate at left side of embankment above gate chamber

(7) Condition of Grass Slope Protection

Generally well maintained.

d. Abutments

(1) Erosion of Contact of Embankment with Abutment from Surface Water Runoff, Upstream or Downstream

Minor at right abutment

(2) Springs or Indications of Seepage Along Contact of Embankment with the Abutments

At right abutment.

(3) Springs or Indications of Seepage in Areas a Short Distance Downstream of Embankment - Abutment Tie-in

Area downstream of right side of dam is wet and covered with marsh vegetation. The area appears to be filled up above original ground level

e. Area Downstream of Embankment, Including Tailrace Channel

Brick enclosed spring on the left abutment about 200 ft downstream of toe

(1) Localized Subsidence, Depressions, Sinkholes, Etc.

Wet ground and downstream of the valve chamber in the area of the approach to the chamber

(2) Evidence of "Piping" or "Boils"

Seepage from left wall of valve chamber approach, also seepage inside of valve chamber and pipe conduit.

(3) Unusual Presence of Lush Growth, such as Swamp Grass, etc.

See above

(4) Unusual Muddy Water in Downstream Channel No

Reddish yellowish deposit or growth where seepage water contacts air

(5) Sloughing or Erosion Masonry walls of tailrace channel have moved inward on both sides. Some stones fall off wall into downstream channel.

(6) Surface Cracks or Evidence of Heaving Beyond Embankment, Toe

Portion of wall left of valve chamber moved about 3" downstream and 2" in vertically. Some cracks on wall right of valve chamber.

(7) Stability of Tailrace Channel Sideslopes

Side walls were noted but appear to be stable

(8) Condition of Tailrace Channel Riprap

No riprap

(9) Adequacy of Slope Protection Against Waves, Currents and Surface Runoff

some adequate

(10) Miscellaneous some debris in tailrace channel

f. Drainage System No relief wells. The drainage ditches at both right and left embankment toes

(1) Condition of Relief Wells, Drains and Appurtenances

The two ditches are not suitable for their purpose in their present condition. On the right side erosion protection is needed, on the left side the present conditions seem to be satisfactory.

(2) Unusual Increase or Decrease in Discharge ~~from Relief Wells~~

The Section Engineer thought that the seepage on the right abutment somewhat increased recently. Also there is a new seepage spot on the right wall of the valve chamber.

4. Instrumentation

(1) Monumentation/Surveys No monuments on the spillway structure have been noted to have been established or maintained since the structure

(2) Observation Wells None

(3) Weirs None

(4) Piezometers 11 standpipe piezometers in the crest and downstream slope. These are not in use

(Other)

5. Reservoir

a. Slopes Appear to be stable.

b. Sedimentation No indication of excessive sedimentation

6. Spillways

a. Principal Spillway: Inlet Condition * [illegible] 9979 x other [illegible]

Pipe Condition

General Remarks (include information such as recently repaired, potential for debris accumulation, special items of note, etc.)

* Upstream ends of both inlet walls are damaged Looking upstream a large block of masonry on the left sidewall has been dislodged. The alignment for the right side has been somewhat altered.

b. Emergency Spillway: General Condition Chute of spillway seemed in good condition. Blockouts in walls and sill for flashboards appeared in good condition.

Tree Growth

Erosion

Other Observations See Note 1. on next page. Holes for flash boards were visible but no longer used.

7. Structural (if required) See Attached Appendix

Stability calculations are not required for Phase I Dam Inspection.

Note 1.

With small quantities of water flowing smoothly over and down the spillway chute a large number of "rooster tails" were formed at the intersection of the horizontal and vertical joints in the masonry chute. Inspection of the spillway when water is not flowing down chute would reveal the presence of leakage, if any.

8. Downstream Channel

Immediately downstream of the spillway chute the channel on the old river bed is masonry lined. Some debris in tailrace channel.

a. Condition (obstructions, debris, etc.)

b. Slopes

c. Approximate No. Homes and Population

d. General

K. Lman Sealey

TEAM CAPTAIN

STRUCTURAL INSPECTION CHECKLIST

PHASE I DAM INSPECTION

Dam type - Earthfill with masonry core. There are no

1. Concrete Surfaces exposed concrete surfaces. The spillway walls and chute are finished with masonry blocks. The downstream portion of the chute is also a masonry-lined channel in the old river bed

2. Structural Cracking No structural cracking is visible.

3. Movement - Horizontal and Vertical Alignment There is no apparent change in either the horizontal or vertical alignment of the spillway. There are USGS survey points close to the spillway structure but they have not been used to check the alignment of the structure.

4. Junctions with Abutments or Embankments Some surface erosion of embankment was noted on crest near sides of spillway walls.

5. Drains - Foundation, Joint, Face No drains under the spillway structure are visible or indicated on the drawings.

6. Water Passages, Conduits, Sluices In addition to the water over the spillway there is a fountain outlet on the left side of the tailrace (see sketch) supplying water to the downstream channel

7. Seepage or Leakage Masonry sidewalls of spillway show only minor cracks and some water seepage from the joints and cracks. Because water was flowing over the spillway at was difficult to check the apex section where the stone facing is sound and shows no sign of movement.

8. Monolith Joints - Construction Joints There are no concrete structure - no monolith joints or construction joints.

9. Foundation No apparent problem. Stone facing at base of chute is sound and shows no sign of movement or cracking.

10. Abutments There are no structural (concrete) abutments

11. Control Gates There are no structural or mechanical control gates on the spillway. There is provision for spillway stoplogs but none are available.

12. Approach and Outlet Channels Both spillway inlet walls at reservoir level are in damaged condition. Some large stones of the inlet masonry walls are loose and some have been dislodged. The walls of the tailrace, downstream of the spillway chute, have moved inward on both sides. Some stones in the tailrace walls are loose and some have fallen into the channel

13. Stilling Basin – There is no stilling basin

14. Intake Structure This tower structure, partially submerged, is located in the reservoir directly upstream of spillway and is also lined with finished masonry stones. It looked in good condition and no problems were reported to us by local personnel. No boat was provided to gain access for inspection.

15. Settlement – No apparent or significant settlement of spillway structure

16. Stability

a. Overturning } No computations are available for the spillway structure.

b. Sliding } None are required.

c. Seismic } After 50 years of operation - none seem necessary.

17. Instrumentation

a. Alignment None installed.

b. Uplift

c. Seismic

18. Miscellaneous Spillway apex and chute should be checked for leaks when reservoir level is below spillway crest.

Obtain use of boat to check condition of intake tower.

HYDROLOGIC DATA AND COMPUTATIONS

APPENDIX E

TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS NEW YORK

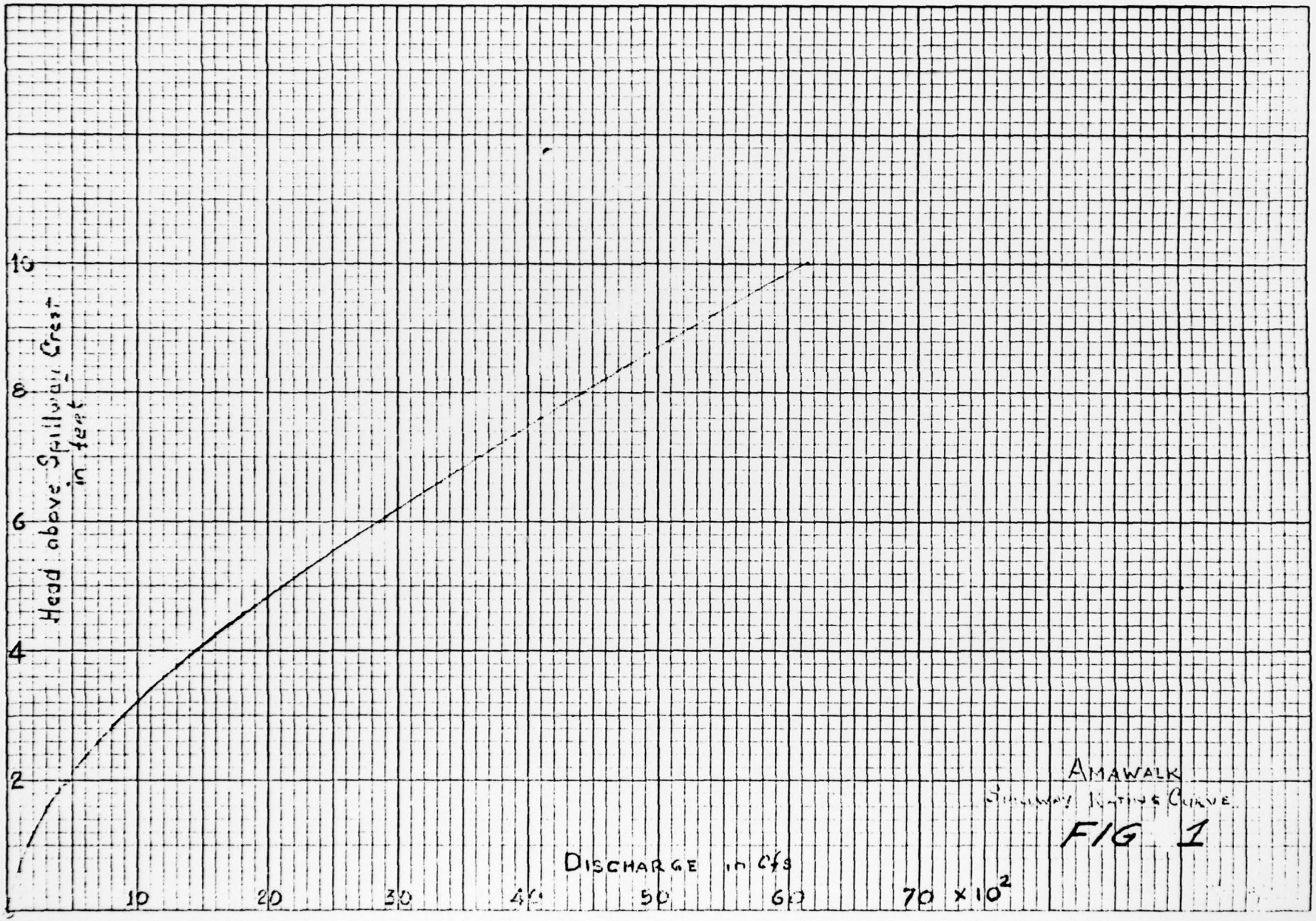
Job No. 1487 Sheet ___ of ___
Project Dam Inspection Date 5-17-
Subject Assonet Dam By GKH
Spillway Rating Curve Chk. by ___

Spillway Rating Length = 50', Crest Elev. 400

Head	C	Q
1.0	3.0	150
2.0	3.2	452
3.0	3.4	883
4.0	3.6	1440
5.0	3.9	2180
6.0	3.9	2866
8.0	3.9	4412
10.0	3.9	6166

Floods of Record

Date	Elev.	Head	Q	
Aug. 20-21, 1955	403.33	3.33	1054	
Oct. 18, 1955	403.75	3.75	1289	8.60" in two day



AMAWALK
Spillway Rating Curve
FIG 1

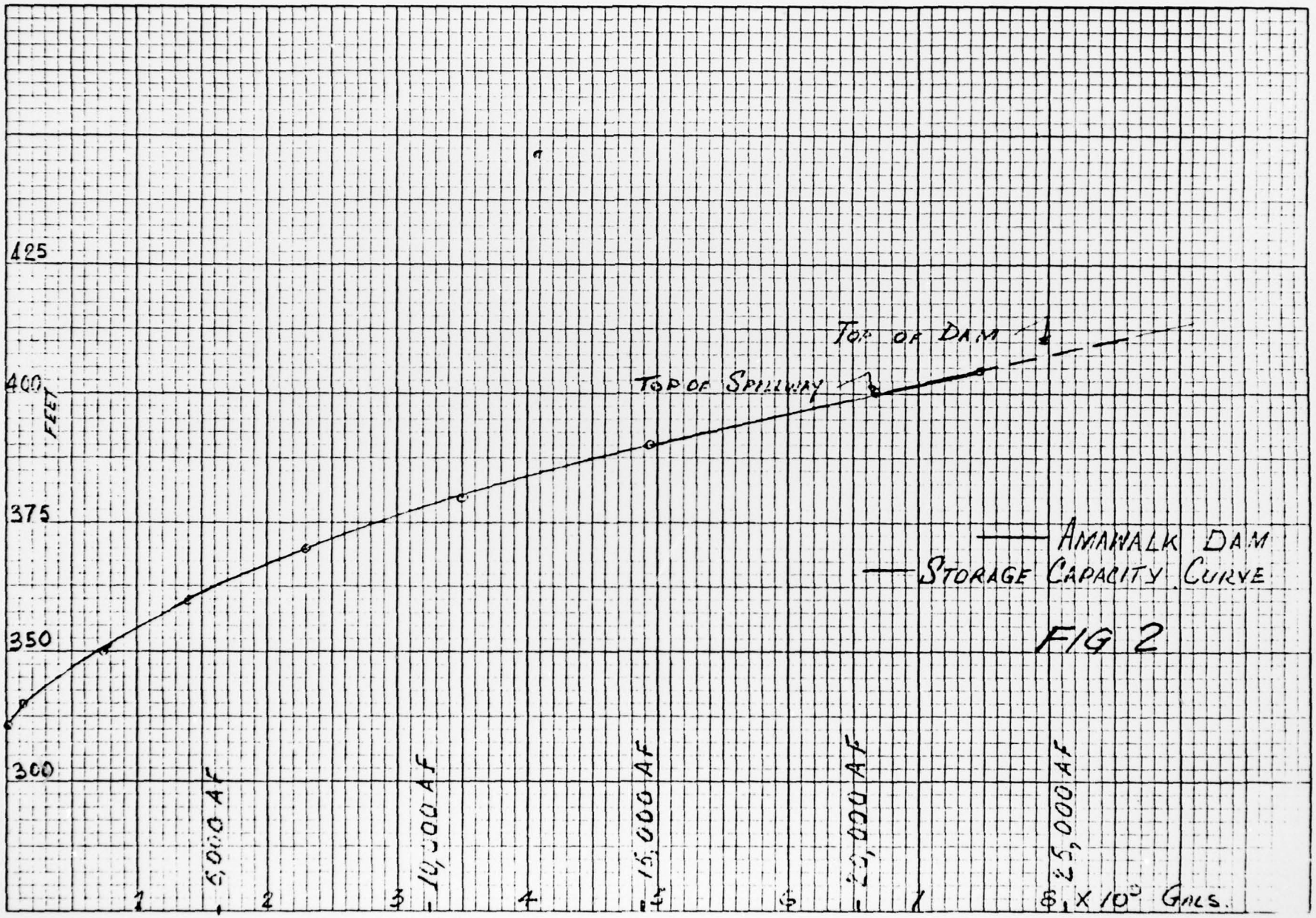

425
400
375
350
300
FEET
TOP OF DAM
TOP OF SPILLWAY
5,000 AF
10,000 AF
15,000 AF
20,000 AF
25,000 AF
1
2
3
4
5
1
$, X 10⁶ GALS.
AMAHALK DAM
STORAGE CAPACITY CURVE

FIG 2

LIST OF REFERENCES

APPENDIX F

APPENDIX F

REFERENCES

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READ INSTRUCTIONS BEFORE COMPLETING FORM

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Croton River Basin, Westchester Co. N.Y.
Inventory No. 45

5. TYPE OF REPORT & PERIOD COVERED
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National Dam Safety Program

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
(10) Eugene O'Brien, ~~P.E.~~

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411 046

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(6) National Dam Safety Program. Amawalk Dam (Inventory Number 45), Croton River Basin, Muscoot River, Westchester County, New York. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Amawalk Dam
Westchester County
Muscoot River
City of New York
Water Supply System

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Amawalk Dam was judged to be unsafe-non-emergency due to a seriously inadequate spillway.

411 046

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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